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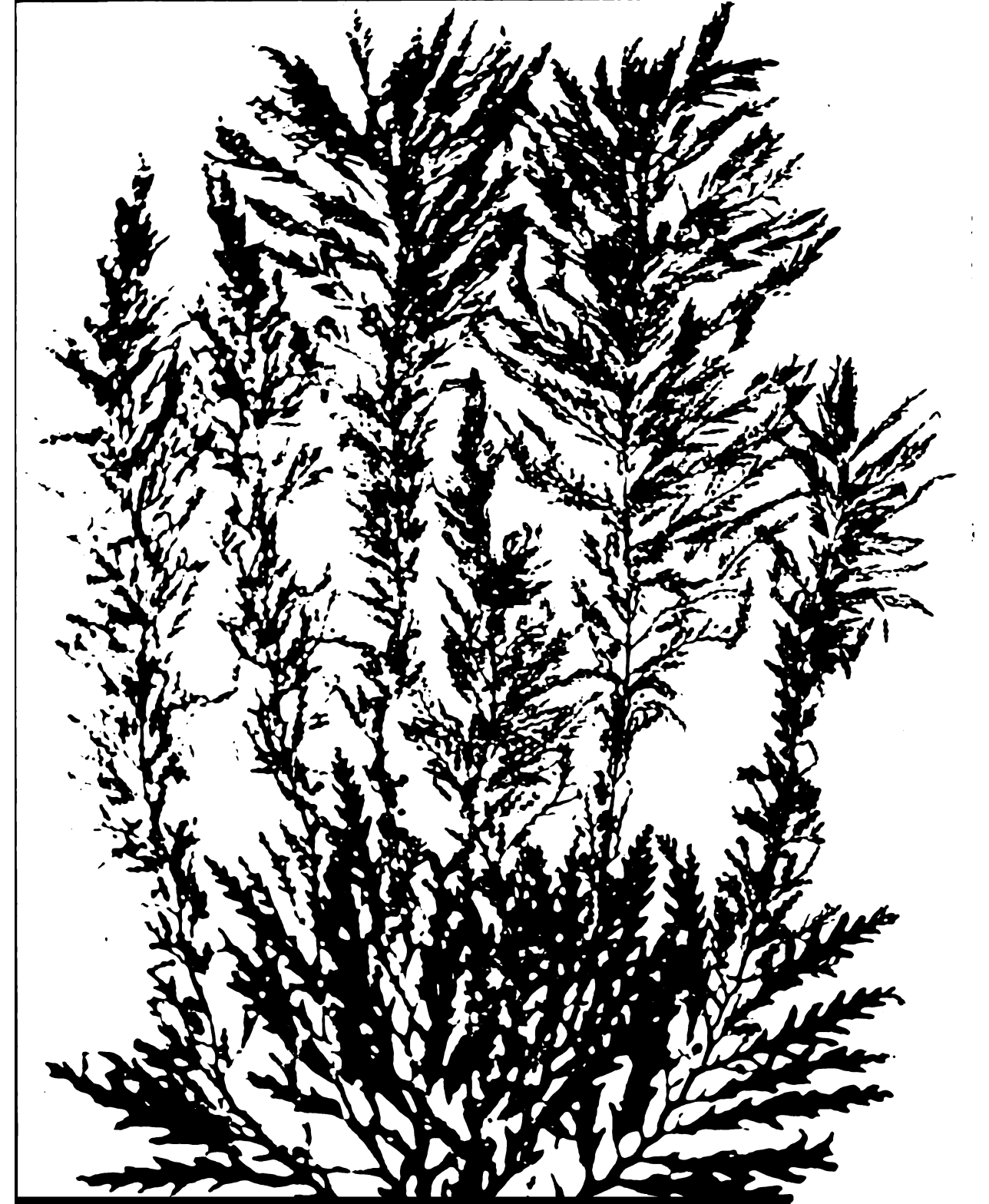

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IN

BOTANY

WILLIAM ALBERT SETCHELL
EDITOR

VOLUME 4

WITH 63 PLATES

UNIVERSITY OF CALIFORNIA PRESS
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STUDIES IN ORNAMENTAL TREES AND SHRUBS

BY
HARVEY MONROE HALL

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INTRODUCTION AND ACKNOWLEDGMENTS.

The people of California are slowly coming to a realization of the fact that the climatic and soil conditions of this state are suitable for the growth of the best ornamentals that the world affords, and that they have the opportunity here to develop a high-class system of landscape gardening. This realization is leading to a demand for more information concerning the better sorts of ornamental shrubs and trees. The object of the present paper is to aid in supplying such information and is at the same time a critical botanical study of the species here presented.

Many of our best ornamentals are scarcely known outside of the grounds of a few wealthy citizens who have introduced them for their own pleasure, others are appreciated only by certain communities. Some of these desirable sorts are here given attention in order that their use may become more general. It is especially hoped that small grounds and yards may be planted with only the best, but it is also hoped that those interested in laying out villa sites, public parks, school-grounds, cemeteries, railroad parks, and the like, will be stimulated to more care and discrimination in the selection of trees and shrubs, since their choice affects the pleasure of many people throughout many years.

Aside from their ornamental value, many of the plants mentioned in this paper will doubtless be found useful in the work of reforestation. Several species of Hakea, and especially the more drought-resistant sorts of Pittosporum and Melaleuca, are among the most promising shrubs and small trees for chaparral planting in our foothill districts. Certain of the plants here considered will be of much value in California, when better known, because of their edible fruits or nuts. This particularly applies to *Feijoa Sellowiana,* and to *Macadamia ternifolia,* both trees of high ornamental value.

The greatest confusion exists among California gardeners, nurserymen, and architects, concerning the names of many of our plants. This is due, in part, to the fact that they are not grown in eastern or European gardens; hence they are not described in the standard gardening dictionaries. For most of

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the groups here treated, easy, artificial keys to the species have therefore been prepared, and many illustrations added.

The garden investigations were undertaken as a part of the author's duties as assistant botanist to the Agricultural Experiment Station of the University of California. Financial aid was received from grants from the Adams Fund of the United States Government, but this paper is not to be considered as the sole result of these investigations, or even as the most important result. The critical examination of specimens gathered during the course of this study was undertaken at the University, where free use was made of the botanical library and of the herbarium.

It is a pleasure to acknowledge the assistance received from numerous nurserymen, gardeners, and other residents of California, who have allowed the writer a free examination of their plants and supplied much valuable information. Dr. F. Franceschi and Mr. W. H. Morse, of Santa Barbara, Mr. Compton of Montecito, Mr. Ernest Braunton and Mr. L. A. Greata, of Los Angeles, Mr. D. W. Coolidge, of Pasadena, Miss K. O. Sessions, of San Diego, Mr. John McLaren, Superintendent of Golden Gate Park, San Francisco, and many others should be mentioned in this connection. Among the foreign correspondents who have supplied critical notes, or specimens for comparison, it is a pleasure to mention Dr. J. H. Maiden, Government Botanist for New South Wales, Mr. T. F. Cheeseman, of the Museum at Auckland, the late Mr. H. J. Matthews, formerly Chief Forester of New Zealand, and Mr. Joseph Burtt-Davy, Government Botanist for the Transvaal. Mr. C. N. Forbes, of Honolulu, has supplied valuable material from the Hawaiian Islands.

I am indebted to Mr. Harry Evans for the preparation of line drawings used in figures 1 to 13, and to Miss Carlotta Case for the one used in figure 15. The drawings used in plates 3, 4, and 5 are all the work of Mrs. Louise Nash. Of the text figures, no. 2 is adapted from Curtis' *Botanical Magazine,* plate 2246; no. 5 is from Hooker's *Icones Plantarum,* plate 447; and no. 14 is a tracing from Lindley's *Botanical Register,* plate 410. All of the others are original, drawn either from the living plant or from herbarium specimens. All line drawings used in the preparation of the plates are original, except figure 2 of plate 3.

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PITTOSPORUMS CULTIVATED IN CALIFORNIA.

Pittosporum is the generic name of certain ornamental evergreen trees and shrubs which have come to us mostly from New Zealand, Australia, and the neighboring islands. About seventy species are known, of which some fourteen have found their way into California.

The popularity of these plants is due to the ease with which they are grown and to their suitability for planting in various situations. It is a remarkable fact, however, that several of the better sorts are scarcely known to our nurserymen and landscape gardeners. These have been introduced and grown on private grounds where their superior qualities are fully appreciated, but no particular effort has yet been made to extend their cultivation. It is for the double purpose of making these species better known and of providing keys and descriptions whereby any Pittosporum grown in California may be identified, that this account has been prepared.

Special Uses.

It has been said above that Pittosporums are suited to many conditions. The species adapted to special purposes may be grouped as follows:

As a street or avenue tree *P. undulatum* (the Victorian Box) has been much recommended in southern California, especially by Mr. Ernest Braunton, and its rapid growth, large size, and smooth, green leaves are certainly in its favor. It will, however, require careful training and can be expected to attain stately dimensions only where abundant summer heat and some irrigation can be depended upon. A species of much greater promise is *P. rhombifolium,* of which there are now several good examples in California. This has a more erect growth with a single central shaft and pyramidal crown and is gorgeous with orange-scarlet berries for several months in each year. *P. phillyraeoides, P. eugenioides,* and *P. crassifolium* may also be considered in this connection, but are not to be generally recommended.

For hedges *P. undulatum* is the best if a broad, massive hedge is desired. *P. eugenioides* is the best in case a tall, narrow hedge

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is wanted, particularly if a light-green color is preferred. *P. tenuifolium* also may be trimmed into a narrow hedge, but is more twiggy, less leafy, and of a darker green color. Both of these two last-mentioned take very kindly to pruning, making neat hedges generally superior to the much used privet and box. For low hedges and for edgings the rambling, light-green and glossy *P. heterophyllum,* a recently introduced and still rare species, should be considered.

The most fragrant Pittosporums are *P. Tobira* and *P. undulatum.* These are both sweet-scented, the fragrance resembling that of orange blossoms, while the flowers of *P. eriocarpum* have a very pleasing banana-like fragrance.

For general yard and lawn planting, where only a shrub is desired, any of the species here described may be used, except only the tree-like species and the half-reclining *P. heterophyllum.* Even such arboreous sorts as *P. crassifolium* make good shrubs if well headed in, the pruning serving the double purpose of keeping the plant within bounds and of causing it to throw out an abundance of new foliage. In case a mass of gray-colored foliage is desired, *P. eriocarpum* is by far the best.

For reforestation purposes *P. phillyraeoides* is perhaps to be recommended as of most importance because of its drought-resisting powers. It would grow readily on any of our lower ranges without attention but would need to be protected from browsing animals in its early stages. *P. tenuifolium* and *P. crassifolium* are among the most hardy species and could be used throughout the coast counties of California.

Propagation.

The seeds of Pittosporum usually germinate readily, but in California the rarer sorts are occasionally infertile. This is probably due to the absence of cross-pollination, particularly in those cases where the parent plant is the only one of the species in the neighborhood. It is claimed by some that only the spring crop of seeds of *P. rhombifolium* are fertile. *P. phillyraeoides* is perhaps the most difficult species to propagate in this way, but it throws up numerous root suckers which may be separated from the parent and transplanted.

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The most rapid, and for most species the most satisfactory method is propagation by cuttings. These should be taken from the half-ripened wood and seldom fail to strike root if given ordinary care.

It is sometimes desirable to "work over" one species into another after the plant has attained considerable size. While this may possibly be accomplished by the ordinary methods of grafting, at least in some cases, the procedure known to nurserymen as inarching is more likely to prove successful.

Botanical Description of Pittosporum (Family *Pittosporeaceae*).

Shrubs and small trees, mostly evergreen. Leaves simple, without stipules, entire or toothed, mostly alternate but sometimes so crowded as to appear whorled on the twigs. Flowers in terminal corymbs or panicles, or in axillary umbels, or solitary. Sepals 5, either distinct or united at base. Petals 5, rarely distinct to base, usually connivent or cohering in a tube. Stamens 5, free; anthers erect, ovate-oblong. Ovary sessile or short-stipitate, incompletely 2-celled (or rarely 3- to 5-celled). Style short. Fruit a globose, ovate, or obovate capsule, often compressed, sometimes colored and berry-like in appearance, the valves leathery or almost woody, the placentae central. Seeds thick or globular, not winged, smooth but usually embedded in a viscous substance, disagreeable to the taste because of the presence of an aromatic, resinous, or acrid principle. The name "Pittosporum" is derived from two Greek words and may be translated as "pitch seed." This term was chosen because of the pitch-like exudation of the seed-coats just mentioned.

Key to the Species of Pittosporum grown in California.

A. Color of flowers black or nearly so.

Flowers mostly axillary, *i.e.*, each from the axil of a leaf: leaves thin, glabrous .....1. *P. tenuifolium.*

Flowers in terminal clusters: leaves thick.

Leaves with recurved margins, white-tomentose beneath: capsule ¾ to 1¼ in. long, tomentose .....2. *P. crassifolium.*

Leaves with flat margins.

Capsule ⅔ in. long, pubescent: leaves white-tomentose beneath .....3. *P. Ralphii.*

Capsule ¾ to 1 in. long, glabrous: leaves glabrous when mature .....4. *P. Fairchildii.*

B. Color of flowers white, greenish, or yellow.

Leaves very obtuse, thick and leathery.

Flowers ⅜ in. long, in terminal umbels, usually pure white.

Foliage uniformly green .....5. *P. Tobira.*

Foliage variegated with white .....5. *P. Tobira variegatum.*

Flowers ⅜ in. long, in terminal panicles, greenish yellow .....6. *P. viridiflorum.*

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Leaves acute, thin.
Flowers in terminal clusters: leaves lanceolate or broader.
Young foliage glabrous or nearly so.
Petals about ½ in. long: flowers rather few (rarely over 20 in each terminal cluster).
Capsule many-seeded: flowers white, fragrant ....7. *P. undulatum.*
Capsule 4-seeded: flowers greenish yellow.....8. *P. tetraspermum.*
Petals less than ¼ in. long.
Leaves entire or merely undulate: sepals acute.
Erect, with leaves 2½ to 4 in. long.....9. *P. eugenioides.*
Half-reclining, with leaves 1 in. long....10. *P. heterophyllum.*
Leaves coarsely toothed: sepals obtuse.....11. *P. rhombifolium.*
Young foliage and capsules very pubescent.
Leaves 7 to 10 in. long, abruptly narrowed to a long petiole .....12. *P. hawaiiense.*
Leaves smaller, tapering to the petiole.
Tomentum rusty: leaves 2 to 3 in. long .....13. *P. revolutum.*
Tomentum white: leaves 4 to 6 in. long .....14. *P. eriocarpum.*
Flowers axillary, i.e., each from the axil of a leaf.
Leaves glabrous, flat: flowers yellow .....15. *P. phillyraeoides.*
Leaves tomentose underneath, margins rolled back: flowers purple and yellow .....16. *P. bicolor.*

1. **P. tenuifolium** Gaertn. *P. nigricans* Hort.

A shrub or small tree, rarely exceeding 30 ft., of symmetrical and compact growth: bark black: leaves glabrous and shining when mature, oblong or somewhat obovate, acute or rarely obtuse, 1 to 3 in. long, thin or almost membranous, the margins wavy: flowers solitary in the leaf-axils or rarely fascicled: corolla ¼ to ½ in. long, dark purple: ovary silky: capsule ½ in. long, globose, 3-valved, glabrous and minutely roughened when mature. New Zealand.

One of the best sorts for mass planting and for hedges in California. Its clean, thrifty growth makes it desirable for planting near houses and especially for screening undesirable views. An occasional judicious pruning is necessary in order to get a good foliage effect and to hide the stems.

A yellow-flowered form of this species has just been discovered in Berkeley by Miss Katherine Jones. It is represented by but two shrubs growing in a row of normal black-flowered plants, and no other difference can be detected. It will be further studied and propagated for distribution, since the yellow flowers render it more attractive than the ordinary sort. Mr. T. F. Cheeseman, who has made a careful study of the New Zealand species, writes that although he has not known *P. tenui-*

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folium to produce yellow flowers, he has noted this variation in other dark-flowered species. He has, therefore, no hesitancy in referring our yellow-flowered form to *P. tenuifolium.*

2. **P. crassifolium** Soland. Karo.

A tall shrub or small tree, 15 to 30 ft. high, with erect branches: bark dark brown or black: branchlets, petioles, lower surface of leaves, inflorescence, and ovaries all densely clothed with a white or buff downy pubescence: leaves 2 to 3 in. long, narrow-obovate or oblong, obtuse, much narrowed to the short stout petiole, very leathery, dark green and shining above, the margins recurved: flowers in clusters terminating the branchlets: petals ½ in. long including the recurved tips, nearly black: fruiting peduncle stout, recurved: mature capsule subglobose, ¾ to 1¼ in. long, short-hairy, with very thick woody valves. New Zealand. Illustrations: *Bot. Mag.*, pl. 5978 (wrongly colored); Kirk, *Forest Fl. N. Z.*, pl. 14; *Gard. Chron.*, ser. 3, xxx, fig. 130.

Too coarse and rigid for ordinary yard planting unless frequently pruned back, but with care it may be made to assume a rounded, bushy form which is very pleasing. Suitable for windbreaks and shelter near the sea. In New Zealand (where a yellow-flowered form occurs) it is said to resist the fiercest gales and to grow even where washed by salt spray. The wood is white and tough, used for inlaid work, and is difficult of combustion.

3. **P. Ralphii** T. Kirk.

A loosely branched shrub 8 to 15 ft. high: leaves spreading, 2 to 5 in. long, oblong or oblong-obovate, the margins not recurved: petioles and peduncles rather slender: capsule ⅔ in. long, broadly ovoid, pubescent. New Zealand. Illustration: *Gard. Chron.*, xxvi, fig. 72 (probably this).

Rare in cultivation. I have seen one specimen on the Hale grounds, Santa Barbara, imported through the Brisbane Botanic Gardens. It is more thrifty and apparently of better habit than *P. crassifolium. P. Ralphii* differs from that species in that "the leaves are much larger, oblong, not gradually narrowed into the petiole, and the margins are flat, not recurved, while the capsules are much smaller" (Cheeseman). The Santa Barbara plant bears out this statement except that the leaves are narrowed to the petiole.

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4. **P. Fairchildii** Cheesem.

A compact round-topped shrub 8 to 15 ft. high; leaves 2 to 3 in. long, obovate to elliptic-oblong, broader than in no. 2, glabrous when mature, the margins flat: capsule ¾ to 1 in. long, becoming glabrous when half-grown: otherwise like *P. crassifolium*. New Zealand.

This species has not yet made its appearance here, but is certain to be introduced from New Zealand, where it is grown in gardens. More graceful and compact than *P. crassifolium* and perhaps better suited to general planting.

5. **P. Tobira** Ait. TOBIRA. JAPANESE PITTOSPORUM.

A large spreading shrub with shining dark-green or variegated foliage: bark gray: leaves 2 to 3½ in. long, 1 to 1½ in. wide, obovate and very obtuse, gradually tapering to the short petiole, thick and leathery, the margins recurved, perfectly glabrous: flowers in terminal umbels, fragrant: corolla ⅜ in. long, white or rarely yellowish: capsule ½ in. long, ovoid, 3- or 4-angled, densely short-hairy, tipped with the persistent style. China and Japan. Var. *variegatum* Hort. has the leaves (often thinner) variegated with white. Illustrations: *Bot. Mag.*, pl. 1396; Nicholson, iii, fig. 193 (pot plant); Bailey, fig. 1837; Engler & Prantl, *Nat. Pfl.*, iii, 2a, fig. 62.

Especially valuable because of its deep-green foliage and abundant fragrant flowers, these latter resembling orange blossoms, both in appearance and odor. Suitable for lawns and shrubberies rather than for hedges. Dr. Franceschi states that it withstands violent saline winds better than most other shrubs and is therefore adapted to seashore planting.

6. **P. viridiflorum** Sims. *P. sinense* Desf. GREEN-FLOWERED PITTOSPORUM.

Much like *P. Tobira* but becoming larger, more tree-like and with smaller greenish and yellow flowers in dense compound clusters: ripe capsule subglobose, "glabrous, as large as a pea, 2- to 6-seeded." South Africa. Illustrations: *Bot. Mag.*, pl. 1684; Nicholson, iii, fig. 194.

Very rare as yet in California gardens but one of the best of the larger Pittosporums. A magnificent specimen in Santa Barbara, remarkable for its graceful habit and lively-green, glossy foliage, is 25 feet high, the trunk 10 inches in diameter. The very fragrant flowers are borne profusely during the winter and spring months but the tree sets no fruits, perhaps owing to the absence of pollen from other trees.

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7. **P. undulatum** Vent. VICTORIAN BOX.

Normally a tree, attaining 40 ft. or more, commonly pruned as a shrub in cultivation, with rich deep-green dense foliage: bark gray: leaves 3 to 5 in. long, 1 or 2 in. broad, oblong, abruptly acute, coriaceous and shining, crowded on the branchlets, glabrous, entire, wavy-margined or flat: flowers rarely more than 20 in the compound terminal cluster, fragrant at night: sepals more than ½ as long as corolla, tapering to a slender tip: corolla white, about ½ in. long: capsule barely ½ in. long, nearly globose, smooth, many-seeded. Australia. Illustrations: *Bot. Reg.*, i, 16; Bailey, fig. 1836.

Very suitable for large hedges where a dense foliage effect is desired; stands pruning well, and so can be kept low, but a much greater breadth will be necessary than if *P. eugenioides* is used. Blossoms with us from January to July, the rich jasmine-like odor, particularly noticeable on quiet evenings, making it suitable for planting in small groups or for individual bushes near summer houses, dining porches, and the like. It is also recommended as an avenue tree for southern California where, with plenty of room and careful pruning from beneath, it attains stately dimensions.

8. **P. tetraspermum** Wight & Arn. MADRAS PITTOSPORUM.

A large shrub: leaves 2 to 4 in. long, ovate or lanceolate, very acute, coriaceous, glabrous, the margin obscurely wavy: flowers in a terminal cluster: sepals minute, tapering to a slender tip: corolla yellowish: capsule nearly globose, glabrous, only 4-seeded. India. Illustration: Wight, *Icon.*, iii, pl. 971.

Introduced in 1897 by Dr. Franceschi, but since lost.

9. **P. eugenioides** A. Cunn. TARATA.

A small branching round-headed tree, 20 to 40 ft. high in its native habitat; a tall shrub or slender open tree in cultivation, the rather sparse and glossy foliage of a very light-green color: bark nearly white on the old branches, pale brown on the twigs: leaves 2 to 4 in. long, ¾ to 1¼ in. wide, elliptic-oblong, acute, often conspicuously wavy-margined: flowers numerous in a branched terminal cluster: sepals minute, obtuse: corolla yellowish, under ¼ in. long: capsule rather more than ¼ in. long, ovoid, pointed at each end, 2- to 4-ribbed, glabrous when mature. New Zealand. Illustration: Kirk, *Forest Fl. N. Z.*, pl. 49.

The most extensively cultivated species in California, a favorite because of its hardiness and the yellowish green color of the foliage. Its slender habit and cheerful appearance renders

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it especially valuable where something is needed to relieve the somber appearance of our ordinary dark-green shrubbery. When grown for hedges the plants should be set not more than three feet apart and the lateral branches clipped back occasionally; in a few years it may be trimmed to a narrow hedge. The fragrance, said to be very noticeable in wild trees, seems to be lost in cultivation. "The wood is white, tough, elastic, and of considerable strength, but soon perishes when exposed. It is frequently used by the wood-turner" (Kirk).

10. **P. heterophyllum** Franch.

A low, half-reclining shrub or low hedge plant with light-green foliage: leaves 1 or 2 in. long, ½ to 1 in. broad, lance-shaped or ovate, tapering to both ends but nearly sessile, entire, glabrous: flowers few in simple clusters terminating short branchlets, the peduncles only very rarely divided: corolla light yellow, about ¼ in. long: capsule barely ¼ in. long, globose, minutely pubescent when half-grown, glabrous at maturity. Western China.

Introduced by Dr. Franceschi in 1908, his specimens with small ovate leaves. In China the leaves are extremely variable in size and shape, even on the same branch. Dr. Franceschi recommends it for large rockeries and embankments, and states that it is drought resistant.

11. **P. rhombifolium** A. Cunn. QUEENSLAND PITTOSPORUM.

A tree of pryamidal growth, said to reach 60 to 80 ft. in height: leaves 3 to 4 in. long, 1 or 2 in. wide, rhomboid, being broadest in the middle and tapering to each end, acuminate, coarsely and irregularly toothed, glabrous: flowers numerous in a wide compound terminal cluster: sepals rather obtuse, about one-half as long as the corolla, this ⅛ to ¼ in. long and white: capsule berry-like, ¼ in. long, nearly globose, tipped by the persistent style and rounded to a short-columnar base, passing from green through lemon color to bright orange-yellow, glabrous. Australia. Illustration: Hooker, *Icon.*, pl. 621.

Little known in California but one of the very best sorts. Sometimes grown as a pot plant, in which case it remains small, and serviceable when young as a shrub, since it flowers when only 5 or 6 feet high, but most valuable for avenue planting and as a specimen tree for lawns and yards. Its central shaft gives it an erect habit, the foliage is clean and thrifty, the flowers not very showy and rather faintly odorous, the bright-yellow berries

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very conspicuous and the most pleasing feature of the tree. The flowers appear in June and July and the berries persist through the autumn and winter. These berries contain but few fertile seeds, although there is a small spring crop in which the percentage of viability is greater. This species is also propagated by cuttings. Specimens may be seen at the Gould place, Montecito; the Sexton place, Goleta; at Soldiers Home near Los Angeles; and at the Fowler place, Pasadena.

12. **P. hawaiiense** Hilleb.

A small tree 12 to 15 ft. high, with few branches: leaves of the largest, being 7 to 10 in. long and 2 to 3 in. wide, acute, thick, slightly hairy beneath when young or even silvery white in one form, entire: flowers in terminal clusters: corolla cream color: ovary tomentose: capsule 1 in. long, probably globose, rough. Hawaii.

Introduced by Dr. Franceschi in 1907. A promising Pittosporum but probably tender and not very well known.

13. **P. revolutum** Ait.

A tall shrub, the young branchlets and petioles and the flower-stalks covered with short rusty hairs: leaves 2 to 3 or 4 in. long, 1 to 1½ in. wide, elliptic, narrowed to each end, entire or slightly wavy-margined, glabrous above when mature, rusty-pubescent underneath, crowded towards the ends of the branchlets: flower-clusters terminal, rarely a few in the axils of upper leaves: sepals with very slender tips: petals ½ in. long or rather more, pale yellow, often united part way to form a cup-shaped corolla, the free tips recurved: ovary very hairy: capsule ½ to ¾ in. long, with numerous red or brown seeds. Australia. Illustration: *Bot. Reg.*, iii, pl. 186.

Grown in England as a greenhouse shrub but flourishes out of doors at Berkeley. Not particularly desirable except in collections.

14. **P. eriocarpum** Royle.

A large bush or widely spreading bushy tree 10 to 20 ft. high, with light-green foliage and light-gray bark: leaves 4 to 6 in. long, 1½ to 2½ in. wide, elliptic or oblong, narrowed to each end, the margins either minutely wavy or flat, tomentose when young, becoming smooth at least above in age: flowers numerous in an oblong terminal raceme, very fragrant, their stems densely white-tomentose: sepals small, acute: petals yellow, somewhat exceeding ½ in., forming a tubular corolla, the tips recurved: ovary very hairy: capsule ⅜ in. long, nearly globose, rough but nearly glabrous. Himalayas. Illustration: *Bot. Mag.*, pl. 7473.

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So far as I know there are but two specimens of this species in California, one at the Gillespie place, Montecito, one in Elysian Park, Los Angeles. Both are noble examples and should incite to further planting. Where a mass of light-colored foliage is desired nothing could be more effective and the fragrance of the banana-scented flowers is very pleasing.

15. **P. phillyraeoides** DC. NARROW-LEAVED PITTOSPORUM.

A graceful tree with habit of the weeping willow but evergreen, 20 ft. or more high, the bark smooth and gray on the branches, becoming checked on the trunk: leaves light green, 2 to 3½ in. long, about ¼ in. wide, linear, tapering to the base, acuminate and the slender tips recurved, entire, equally distributed over the slender pendant twigs, glabrous: flowers fragrant, pediceled, solitary in the leaf-axils (several in each axil in some Australian specimens), the tube ¼ in. long and the recurved portion ⅛ in., yellow: sepals minute: capsule about ½ in. long, oval, compressed, the base somewhat heart-shaped, yellow, the surface granular. Australian deserts. Illustrations: Pl. 1; Maiden, *Forest Fl. N. S. W.*, pl. 4.

This remarkable tree was introduced perhaps in the seventies but its value has been appreciated only within the last year or two. Eminently adapted to dry places and should be tried in our desert country, where, however, it cannot be expected to reach the size attained in the coast counties. The foliage is too sparse for a good shade tree but its slender, pendant branches recommend it as a substitute for the weeping willow, where an evergreen is desired. Propagation from seeds is effected with some difficulty in California, but young plants are now offered by several of the nurseries at Santa Barbara and Goleta. The abundant root suckers may be transplanted if one goes to a considerable depth in digging them, for this tree is deep-rooted. In Australia a sort of bread is prepared from the pulverized seeds and the leaves are browsed by live stock.

16. **P. bicolor** Hook.

A small tree, sometimes 40 ft. high in its native habitat, sometimes only a bush, the young twigs hoary or rusty with a close tomentum: leaves 1 or 2 in. long, about ¼ in. wide, linear, acute, entire but the margins rolled back, glabrous above, tomentose beneath: flowers solitary or several in the leaf-axils: petals ½ in. long, spreading or recurved above, yellow and purple: ovary very hairy: capsules rounded, red and berry-like, "about the size of peas," somewhat compressed. Australia.

Rare in cultivation; once grown at Lincoln Park, Oakland. Hardy in southern England.

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HAKEAS CULTIVATED IN CALIFORNIA.

The Hakeas are all evergreen shrubs and natives of Australia, where about one hundred species are known. Those so far introduced into California, eleven in number, are here grown exclusively for ornamental purposes, although several of them (particularly *H. suaveolens* and *H. gibbosa*) could be used to advantage as a chaparral covering for many of our lower mountains and foothills. These species are quite hardy, require neither abundant moisture nor cultivation, and, through their rigid, spiny foliage, are well protected from animals.

The ornamental value of Hakea lies chiefly in its foliage. This is exceptionally beautiful in the broad-leaved *H. elliptica,* where the new growth is of a most beautiful bronze color, or in some lights almost golden. It is a very satisfactory subject for lawn or yard planting where something aside from the usual dull green is desired. *H. nitida* with its holly-like, bright-green leaves is also to be considered in this connection, while if a pale green is desired *H. undulata* should be chosen. The last three species treated in this paper are also grown for their foliage but should be used only where a rigid effect is desired or as a hedge impenetrable to animals and pedestrians.

The only species with showy flowers, so far as our forms are concerned, is *H. laurina,* and even here our interest is aroused more by the oddity of the flower than by its beauty. The abundant scarlet balls of flowers emitting the long golden styles are sometimes two and one-half inches in diameter and render this a most striking shrub, so much so that in Italy it has been referred to as "the glory of the gardens of the Riviera." The remaining species have mostly smaller white flowers.

Botanical Description of Hakea (Family *Proteaceae*).

Australian evergreen shrubs with alternate ex-stipulate leaves of diversified shape, being flat and broad in some species (and then either entire or merely toothed), terete in others (and then either simple and entire or pinnately parted). Pubescence mostly of appressed hairs attached by the middle, or the plant glabrous. Flowers in pairs, the pairs commonly crowded in close racemes or globose clusters which are mostly sessile in the leaf-axils. Corolla irregular, the tube slender, usually recurved under the limb which is mostly globular, the 4 lobes cohering

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long after the tube has opened. Anthers sessile in the base of the concave perianth-lobes. Ovary stipitate or nearly sessile. Style either long and protruding or short, dilated at the end. Fruit a hard woody capsule, opening in 2 valves. Seeds 2, compressed, winged above, the wings sometimes continued down the sides.

Key to the Species of Hakea grown in California.

A. Leaves mostly ½ in. or more wide (narrower only in *H. saligna*).
Margins of leaves entire and flat.
Leaves pinnately veined, or the veins obscure: flowers white.
Foliage pale: leaves entire, obtuse, callous-tipped: corolla recurved .....1. *H. saligna.*
Foliage bright green: leaves sometimes toothed, sharp-pointed: corolla straight .....2. *H. nitida.*
Leaves parallel-veined: flowers crimson.
Veins 3 to 7: flower-clusters globular: capsule ¾ in. or more broad .....3. *H. laurina.*
Veins numerous: flower-clusters oblong: capsule ½ in. broad .....4. *H. multilineata.*
Margins of leaves wavy (undulate).
Leaves veinless or obscurely feather-veined .....2. *H. nitida.*
Leaves several-nerved from the base and with numerous cross-veinlets.
Margins merely wavy; petiole short or none .....5. *H. elliptica.*
Margins wavy and prickle-toothed .....6. *H. undulata.*

B. Leaves terete or very narrowly linear, seldom ⅛ in. wide, sharp-pointed.
Veins several, parallel: leaves flat, about ⅛ in. wide .....7. *H. ulicina.*
Veins wanting: leaves terete.
Leaves thick, mostly pinnately parted and the lobes terete .....8. *H. suaveolens.*
Leaves slender, entire.
Corolla glabrous:[1] capsule ovate, ½ in. or more thick.
Young branches glabrous: capsule ½ to ¾ in. thick .....9. *H. acicularis.*
Young branches hairy: capsule ¾ to 1 in. thick....10. *H. gibbosa.*
Corolla pubescent: capsule lanceolate, slenderly pointed, ¼ in. thick .....11. *H. pugioniformis.*

1. **H. saligna** Knight.

A pale or grayish bushy shrub (attaining 7 ft. at Santa Barbara), glabrous or the young shoots slightly silky: leaves oblong or lance-shaped, 3 to 4 or 6 in. long, obtuse but usually with a minute callous tip, tapering at base to a short petiole, veins sometimes obscure but usually at least a medial and several oblique lateral veins more or less

[1] In using this character, care must be exercised in distinguishing between the corolla proper and the pedicel, which is also white. The pedicel is pubescent in numbers 9, 10, and 11, but the corolla is pubescent only in the last.

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prominent: flower-clusters small, dense, sessile in the axils of the upper leaves: corolla glabrous, strongly recurved: capsule about 1 in. long, ½ to ¾ in. broad, with a short incurved beak, somewhat rough, sometimes covered with conspicuous tubercles. Illustration: Fig. 1.

This makes a good foliage plant but has no special character for which it can be recommended; seldom planted.

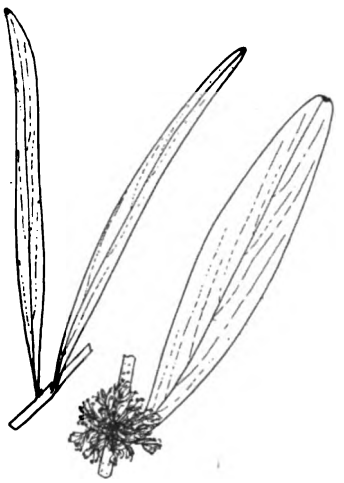

Fig. 1.—*Hakea saligna.*

2. **H. nitida** R. Br.

A large shrub with glabrous and bright-green dense foliage: leaves oblong or narrowly obovate, 1½ to 3 or 4 in. long; either entire, obtuse, and with a small sharp tip, or with a few prickly teeth, acute, and sharp-pointed; thick and veinless or obscurely feather-veined: flower-clusters white, conspicuously stalked in the leaf-axils: corolla glabrous, straight: capsule 1 in. or more long, ¾ in. broad, with a conical horn near the end of one or both of the valves, smooth. Illustrations: Fig. 2; *Bot. Mag.*, pl. 2246.

Fig. 2.—*Hakea nitida.*

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One of the earliest species introduced into England (where protection from frost is necessary). Presumably also grown in California, although no plants can now be located. The pleasing green foliage, suggestive of holly-leaves, may render it desirable.

3. **H. laurina** R. Br. *H. eucalyptoides* Meissn.

A tall shrub, attaining in Australia to 30 ft. and tree-like: branchlets gray with a minute pubescence or reddish and quite glabrous; foliage rusty pubescent when young but soon glabrous: leaves elliptic or lanceolate, narrowed to the apex which is either acute or obtuse, tapering to the petiole, often sickle-shaped, 5 or 6 in. long, ½ to 1 in. wide; with mostly 5 or 7 parallel veins from the base and these sometimes giving off a few obscure secondary veinlets: flowers crimson, very numerous, in dense globular clusters sessile in the leaf-axils: capsule ovoid, short-beaked, about 1¼ in. long by ¾ in. broad, nearly smooth. Illustrations: Fig. 3; *Bot. Mag.*, pl. 7127.

A very vigorous and striking sort with showy crimson flower-clusters from which protrude the long golden-yellow styles. Perhaps the best for dry hillsides where a chaparral covering is desired. Known on the Riviera as "Sea Urchin."

Fig. 3.—*Hakea laurina.*

Fig. 4.—*Hakea elliptica.*

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4. **H. multilineata** Meissn.

A shrub or small tree resembling *H. laurina*: leaves narrow and 6 to 8 in. long, or broader and only 3 to 5 in. long, striate with numerous parallel nerves: flower-clusters oblong, 1 to 3 in. long, sessile in the leaf-axils, carmine in the center, fading to pale pink at the tips of the styles: capsule ovoid-globular with a very short beak, about ½ in. broad. Illustration: *Gard. Chron.*, ser. 3, xix, fig. 14 (var.).

This has been reported from California gardens but all of the specimens seen were found to be *H. laurina*.

5. **H. elliptica** R. Br.

A neat erect shrub 6 to 10 ft. high: old herbage pale and glabrous but young twigs and leaves bronzed with a rich rusty pubescence: leaves oval or elliptic, obtuse or with a small callous point, nearly or quite sessile, 2 to 3½ in. long, 1 to 1¼ in. wide, wavy-margined; the 5 to 7 parallel veins conspicuous on both sides and connected by numerous veinlets (reticulate): flower-clusters globose, sessile in the leaf-axils: capsule ovoid, with a stout oblique beak, 1 to 1¼ in. long, ¾ in. broad, usually smooth. Illustration: Fig. 4.

This is the best sort so far tried for general lawn and shrubbery planting, because of its sturdy growth, compact habit, and especially on account of the beauty of its young foliage. The rich bronze color of the young shoots is equalled, so far as I know, only in certain rare species of Roupala (see p. 44).

6. **H. undulata** R. Br.

An erect shrub 6 to 8 ft. high: young shoots rusty-tomentose, the adult foliage glabrous: leaves obovate, oblong, or rarely lanceolate, obtuse, tapering to a conspicuous petiole, 2 to 4 in. long, the margins wavy and sharply toothed; parallel nerves 3 or 5, connected by many cross veinlets: flowers in sessile clusters: capsule recurved at the base, distinctly beaked, 1 to 1¼ in. long, ½ to ¾ in. broad, rather rough. Illustrations: Fig. 5; Hooker, *Icon.*, pl. 447.

Reported from California but I know of no specimens growing in the state.

7. **H. ulicina** R. Br.

A tall shrub with erect branches and dense foliage not unlike that of the Furze, or Gorse: twigs reddish, usually pubescent when young: leaves (glabrous at maturity) all narrowly linear, flat, acute and sharp-pointed, entire, varying in length from 1 to 8 in., very rarely over ⅛ in. wide, prominently 1- to 3-nerved underneath: flowers very small, the pedicels and corolla glabrous: capsule rarely over ½ in. long, with a short straight beak. Illustration: Fig. 6.

Perhaps not yet grown in California.

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8. **H. suaveolens** R. Br. *H. pectinata* Colla.

A dense rounded shrub becoming 8 to 10 ft. high in California: young shoots and foliage silky pubescent but glabrous at maturity: leaves 2 to 4 in. long, about 1/16 in. thick, cylindric, with a rigid spine-like tip, narrowly grooved on the upper side, occasionally entire but usually branched into 1 to 5 rigid cylindric lobes of various lengths: pedicels and perianth glabrous: flowers white, fragrant: capsule ovoid, about 1 in. long and 3/4 in. broad, narrowed at apex and with a small conical horn near the end of one or both the valves. Illustration: Fig. 7.

This is perhaps the most common of all the cultivated Hakeas. It is easily grown, endures drought, and, by means of its spiny

Fig. 5.—*Hakea undulata.*

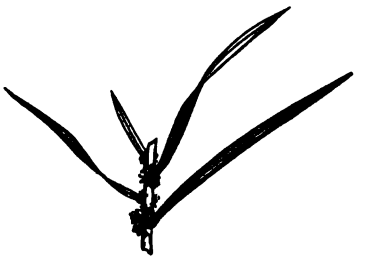

Fig. 6.—*Hakea ulicina.*

foliage, resists the depredations of animals and vandals. For public parks, depot grounds, and the like, no shrub could be selected which would be better able to care for itself, and it is eminently adapted to planting where an impenetrable hedge is desired. In the vicinity of Santa Barbara, it grows without care or irrigation on the dry hillsides and would undoubtedly make an excellent chaparral covering for many of our mountain slopes.

9. **H. acicularis** R. Br.

A tall shrub or (in Australia) a small bushy tree: twigs and young leaves sometimes minutely pubescent, glabrous when mature: leaves very slenderly cylindric, rigid, awl-like at the sharp tip, entire and simple, not grooved, mostly about 2 in. long (1 to 3 in.): pedicels silky-pubescent: corolla glabrous: capsule ovoid, about 1 in. long and 1/2 in. or rather more broad, rough, contracted to a thick beak, each valve with a conic brown horn near the apex.

Suitable for hedges and for shrubberies. More slender than *H. suaveolens.*

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10. **H. gibbosa** Cav.

A broad shrub, becoming 6 to 8 ft. high: twigs and young leaves hirsute with short spreading hairs: leaves cylindric, rigid, smooth, simple and entire, sharply pointed, 1 to 3 in. long: pedicels densely pubescent: corolla glabrous: capsule ovoid, oblique, about 1½ in. long, nearly 1 in. broad, rough, abruptly contracted to a short oblique beak, each valve with a small dorsal horn near the apex. Illustrations: Fig. 8; Cav., *Icon.*, pl. 534; *Bot. Cook's First Voy.*, pl. 266.

Grown on the University grounds at Berkeley, a specimen determined by Dr. J. H. Maiden. Probably also elsewhere in the state but under erroneous names. More slender than *H. suaveolens* and better suited to small private grounds; almost equally as resistant to abuse, and should be tried with that species in reforestation experiments.

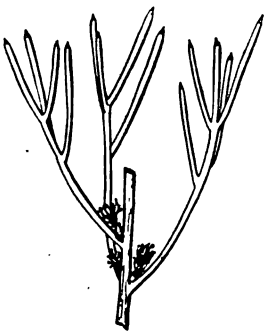

Fig. 7.—*Hakea suaveolens.*

Fig. 8.—*Hakea gibbosa.*

11. **H. pugioniformis** Cav.

A shrub with the habit, foliage, and general characters of *H. gibbosa*, from which it differs as follows: Corolla pubescent: style long, the disk nearly straight: capsule much more slender, lanceolate, acuminate, about 1 in. long and ¼ in. broad, rough around the middle with an obliquely transverse prominent crest, each valve tapering to a slender point. Illustrations: Cav., *Icon.*, pl. 533; *Bot. Cook's First Voy.*, pl. 265.

Grown at Santa Barbara, according to Dr. Franceschi, who says that it is an odd plant, which at a distance looks like a small pine. Some plants found under this name in the trade belong to *H. suaveolens*, a species easily distinguished by the mostly branched leaves and much thicker capsules.

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THE BOTTLE-BRUSH GROUP OF ORNAMENTALS.

Bottle-brushes are eminently adapted to shrubbery and ornamental planting in California. They are rapid growers, hardy, endure considerable drought and abuse, and many of them are among the most showy of our cultivated shrubs.

It has been found, however, that the best sorts are not the ones most generally grown and that selection must be made with regard to the surrounding vegetation and to the particular needs. It is also to be remembered that what at first appears to be an undesirable form may become one of the best if given proper treatment, especially as regards pruning. It is hoped that the following notes will be of some assistance in these matters, but the chief aim has been to give an account whereby the different species may be determined. There is perhaps no group of ornamentals, generally planted in California, in which there is a greater confusion as to names, and the current horticultural publications are of but little assistance.

The most elaborate account of this group is to be found in Bentham's *Flora Australiensis,* and this work has formed the basis for my own determinations, aided by more recent scattered papers, a comparison of herbarium specimens from Australia, and certain critical notes very kindly supplied by Dr. J. H. Maiden, the Government Botanist of New South Wales.

The members of the Bottle-brush group are mostly Australian trees and shrubs belonging to the Myrtle Family (Myrtaceae), which may be characterized as follows:

Botanical Description of the Myrtaceae.

Leaves simple, entire, containing oil or resins which are mostly fragrant and commonly give a dotted appearance to the leaf: calyx-tube adnate to the ovary, 4- or 5-toothed, or the teeth wanting: petals as many as the calyx-teeth, sometimes wanting, sometimes united into a cap and falling away together: stamens numerous, attached to a disk lining the calyx-tube and above the ovary: style simple, with a small round or flat stigma: ovary inferior, mostly 2- to several-celled, maturing into a capsule which is adnate to the calyx-tube (as a matter of convenience the term *capsule* is here used as including both the capsule proper and the enclosing persistent calyx-tube, the whole constituting the botanical "fruit"): ovules commonly numerous but the fertile seeds often few.

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In addition to the Bottle-brush group there are a number of related genera, all members of the Myrtle Family, more or less common in cultivation. Such are the Eucalypti, of which something like 100 species are now grown in California. There is also a genus, Angophora, distinguished from Eucalyptus by the five small calyx-teeth and colored petals. *Angophora lanceolata* and *A. intermedia*, both with ribbed, turbinate capsules, are grown here. The former is a tree with smooth, deciduous bark, the latter is a tree with rough, persistent bark. *Syncarpia laurifolia* is sometimes mistaken for Eucalyptus but has distinct petals and the fruits are fused into a small head.

Tristania conferta is a related tree resembling our native Madroñe in general habit. It has conspicuous flowers with five petals each and the stamens united into bundles. The Australian Brush Cherry (*Eugenia*), with fleshy, edible fruits, is also a member of the Myrtaceae. Kunzea is a genus of slender heath-like shrubs with small leaves, belonging to this family but seldom seen in cultivation.

Six other genera, all natives of Australia and surrounding regions, are of especial interest in California gardens and parks. These constitute what may be considered the Bottle-brush group and may be distinguished by the following key:

Key to the Genera.

Anthers attached by the middle (leaves various: stamens either united or distinct).
  Flowers in spikes or heads or solitary in the leaf-axils.
    Stamens much longer than the petals: flowers in dense clusters.
      Filaments not united or only slightly united at the very base ..... *Callistemon* (p. 22).
      Filaments united into 5 clusters ..... *Melaleuca* (p. 27).
    Stamens shorter than the petals.
      Leaves not 1 in. long: flowers not in close heads, white ..... *Leptospermum* (p. 35).
      Leaves 2 to 6 in. long: flowers in small close heads, white ..... *Agonis* (p. 36).
  Flowers in loose terminal cymes ..... *Metrosideros* (p. 36).
Anthers attached by the base: leaves terete, punctate: stamens red, united ..... *Calothamnus* (p. 37).

CALLISTEMON.

The name *Bottle-brush* is particularly applicable to this genus of shrubs, the flowers being arranged in dense cylindrical spikes

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in which the protruding stamens correspond to the bristles of a brush the handle of which is represented by the woody stem. "Chimney-sweep" is another suggestive appellation sometimes used.

Callistemons are favorites in California gardens and deserve to be even better known. They are perfectly hardy with us, endure considerable drought, and take kindly to pruning. In fact, severe autumn pruning is essential if masses of winter and spring bloom are desired. By this means the shrubs may be kept down to almost any desired size, while with but little pruning they may be allowed to occupy large corners or used as border shrubs for wide driveways. They are especially recommended for parks, depot-grounds, schoolyards, cemeteries, and for large private grounds; also for smaller yards, if used in moderation and kept well pruned. *C. brachyandrus* differs from the other species in being suitable for small grounds and is one of the very good shrubs that is little known. It is especially serviceable in adding grace and airiness to an otherwise somber yard.

The propagation of Bottle-brushes is not difficult. Seed is formed in abundance and although only a small percentage may be fertile there is seldom difficulty in getting a good stand. But seedlings are slow in reaching the flowering stage and because of this cuttings are commonly used. These should be taken in spring from ripened wood or at least from wood which is getting firm at the base. Three or four inches is about the proper length and propagation is best affected in sand under glass.

The identification of our garden forms is no easy task, since there are several apparent hybrids to be taken into account, as well as numerous cultivated forms. It is also to be remembered that among nurserymen this genus is occasionally united with Metrosideros, a union which the botanist cannot countenance. Since, however, the species names under Metrosideros are but seldom correctly applied, it would be as well for all interested to familiarize themselves with the proper names under Callistemon.

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Key to the Species of Callistemon grown in California.

A. Stamens ¾ to 1 in. long.

Leaves lanceolate or oblong (mostly ¼ in. or more wide).

Spikes rather loose: leaves with prominent midrib and lateral nerves .....1. *C. lanceolatus.*

Spikes very dense, more highly colored: leaves thicker and lateral nerves obscure .....2. *C. speciosus.*

Leaves linear (less than ¼ in. wide).

Leaves flat, with prominent midrib, feather-veined.....3. *C. rigidus.*

Leaves channeled above, midrib and lateral veins obscure .... 4. *C. linearis.*

B. Stamens ½ in. or less long.

Leaves flat: stamens pale .....5. *C. salignus.*

Leaves cylindric: stamens bright red, with yellow anthers ....6. *C. brachyandrus.*

Fig. 9.—*Callistemon lanceolatus.*

Fig. 10.—*Callistemon speciosus.*

1. **C. lanceolatus** DC. *Metrosideros semperflorens* Lodd.

A tall shrub with erect or spreading but seldom curved branches: leaves lanceolate, 1¼ to 2½ in. long, about ¼ in. wide, sharp-pointed, midvein and lateral nerves prominent: flower-clusters 2 to 4 in. long, not so dense as in the next species, bright red (rarely smaller and pale): stamens mostly 1 in. long: capsule ovoid, contracted at the summit. Illustrations: Fig. 9; *Bot. Mag.*, pl. 260; Cav. *Icon.*, pl. 332; Bailey, fig. 320; *Bot. Cook's First Voy.*, pl. 108; Maiden, *Fl. Pl. and Ferns of N. S. W.*, pl. 8.

This Bottle-brush is one of the most showy and has entered into several of the garden hybrids. Although not so stiff and rangy as *C. rigidus*, it requires severe pruning if a compact, densely flowered shrub is desired. Seldom becomes more than

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8 feet high in California but reaches 30 feet and a trunk diameter of 18 inches in Australia, where the hard and heavy wood is used for wheelwrights' work and many implements, such as mallets.

2. **C. speciosus** DC.

A large shrub or becoming a fair-sized tree: leaves narrowly lanceolate, either obtuse or acute, 1½ to 4 in. long, about ¼ in. broad, with prominent midrib as in *C. lanceolatus* but the leaf thicker and the lateral veins obscure: flowers highly colored, bright red, in very dense clusters (sometimes 6 in. long in Australia, much shorter with us): stamens 1 in. long: capsule nearly globose, the summit truncate and but little contracted. Illustrations: Fig. 10; pl. 2; *Bot. Mag.*, pl. 1761; Nicholson, vol. 1, fig. 327.

This is the most highly colored of all the Callistemons, the yellow or golden anthers contrasting finely with the dark-red filaments. With but little training it forms a graceful shrub with many drooping branchlets, eventually becoming a tree under favorable conditions. One specimen in Santa Barbara, now about 20 years old, is 35 or 40 feet high, and receives no care or irrigation. It has two blooming periods, the best being in December and January, but the second (May-June) again covers the tree with gorgeous balls of color suspended on slender pendant twigs. Numerous named cultural forms are derivatives of *C. speciosus*, the differences lying in varying shades of color, habit, and size.

3. **C. rigidus** R. Br. *C. linearifolius* DC.

A stiffly branched shrub, the branches inclined to be longitudinal or spreading: leaves narrowly linear, rigid, sharp-pointed, 2 to 5 in. long, about ⅛ in. wide, midrib and marginal ribs prominent, cross-nerves spreading nearly at right angles or hidden by numerous oil-dots: flower-clusters deep red, large (rarely small and pale): stamens 1 in. or more long. Illustrations: Fig. 11; *Bot. Reg.*, pl. 393; *Bot. Cook's First Voy.*, pl. 109.

Perhaps the most common form in California. Begins to bloom when only a foot or two high, and if left to itself becomes an ungainly sprawling shrub. Should be frequently pruned up when young and headed in when older. In this way a round-topped, compact, densely flowered shrub 6 to 10 feet high may be obtained.

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4. **C. linearis** DC.

Scarcely more than a variety of *C. rigidus*, being the extreme form with very narrow leaves which are channeled above, and the midvein quite obscure; fruiting calyx more globular and more contracted at the opening.

Fig. 11.—*Callistemon rigidus.*

Fig. 12.—*Callistemon salignus.*

5. **C. salignus** DC.

A tall shrub or small tree (6 to 10 ft. high, in Australia reaching 40 or 50 ft.): leaves broadly to narrowly lanceolate, very acute, 1½ to 3 in. long, mostly ¼ to ¾ in. wide, but much narrower in one variety, very distinctly feather-veined: flower-clusters pale yellow or light pink, 1 to 2 in. long, ¾ to 1 in. wide: stamens ¼ to ½ in. long: capsule nearly globular, with rather large opening. Illustration: *Bot. Mag.*, pl. 1821. Var. *viridiflorus* F. Muell. has leaves only 1 to 2 in. long, thicker, the veins obscure, rigid and sharp-pointed: flowers larger, greenish yellow: habit more erect, rigid, and tree-like. Illustrations: Fig. 12; *Bot. Mag.*, pl. 2602.

Rare in California gardens and not especially desirable. The wood, which is very hard and close-grained, is said to be very durable underground and to dress admirably. It varies from a uniform drab color to dark red.

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Fig. 13.
Callistemon brachyandrus.

6. **C. brachyandrus** Lindl.

A slenderly branched shrub, the young shoots softly hairy, the hairs sometimes persistent and giving the whole shrub a soft gray tone: leaves rigid, terete, or slightly flattened or channeled, sharp-pointed, ¾ to 1½ in. long: flower-cluster 2 or 3 in. long, 1¼ in. wide: stamens about ¼ in. long, the deep-red filaments nearly obscured by the golden-yellow anthers. Illustration: Fig. 13.

Rare with us but very desirable, the combination of the slender twigs, gray foliage, and golden bloom, being a novelty among Bottle-brushes. Requires frequent heading in for best results.

MELALEUCA.

This genus of about 100 species includes a majority of the so-called tea-trees of Australia and many of the shrubs known in California as Bottle-brushes. The flowers are often arranged as in Callistemon, which may be considered the true bottle-brush genus, but the clusters are not so large and showy, except in one species, *Melaleuca hypercifolia.* But if Melaleuca lags behind Callistemon in the matter of brilliant coloring, the various species exhibit more grace and symmetry of outline, and the available species are now so numerous that one or more sorts may be selected for almost any situation.

All of the species here considered are suitable for nearly any locality in California, being hardy, except in the mountainous districts, and capable of withstanding at least moderate drought. It must be remembered, however, that the arboreous species will seldom develop into more than fair-sized shrubs unless given attention and occasional irrigation, and that a combination of warm summers and a moist soil are essential to the luxuriant development sometimes described. So far as I know, no Melaleuca has yet been killed by frost in California.

For ordinary yard planting the best kinds are *M. lateritia* and *M. armillaris,* the former with brick-red flowers, the latter

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slender twigs and very narrow leaves. *M. hypericifolia* is more spreading than either of these, has recurved branches, brilliant red flowers in large clusters, broad leaves, and never attains a great height. For formal planting *M. linariifolia* will be found more suitable, the branches being more nearly erect, more rigid, and with straight firm leaves of a light-green color. *M. styphelioides* and *M. Huegelii* are also formal in their effect and are of a darker green.

Of the arboreous species, *M. leucadendron* is in the lead and is perhaps the only one to be considered for avenue planting. *M. armillaris* grows sufficiently high, at least in the south and when left unpruned, to make a shade for arbors and walks. *M. nesophila* and *M. ericifolia* are also tree-like, the former being especially good where a mass of ordinary foliage is desired.

As a chaparral covering for our foothills, *M. nesophila, M. decussata,* and *M. styphelioides* are recommended.

Members of this genus are more resistant to alkali than are most plants. In Australia *M. ericifolia* and other species are used for fixing muddy shores where the water is strongly saline and *M. leucadendron* is planted in salt swamps where no Eucalypt will live, being protected by its thick, corky bark. The thick-barked *M. nesophila* and *M. styphelioides* could also be used in these situations, the former being the most promising because of its great hardiness and rapidity of growth. Seedlings should never be transplanted to saline soil until they have developed a good root system and are protected by well-formed bark.

The methods of propagation are the same as given for Callistemons.

Key to the Species of Melaleuca grown in California.

A. Inflorescence a cylindric spike.

Flowers red or scarlet: stamens ¾ in. or more long (except in no. 4).

Leaves opposite: stamen-claw very long.

Midrib prominent; leaves ⅛ to ½ in. wide .....1. *M. hypericifolia.*

Midrib obscure; leaves linear .....2. *M. fulgens.*

Leaves alternate, narrow.

Stamens about ¾ in. long, the claws very short: leaves obscurely 1-nerved or nerveless .....3. *M. lateritia.*

Stamens about ¼ in. long: upper leaves striate with 7 or more nerves .....4. *M. genistifolia.*

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Flowers white, blue, lilac, or pink: stamens under ½ in.
Leaves mostly opposite.
Calyx ovoid (the base somewhat narrowed): leaves linear, 1 in. or more long .....5. *M. linariifolia.*
Calyx with broad base partly embedded in the stems at maturity: leaves linear, ¼ to ½ in. long .....6. *M. decussata.*
Leaves mostly alternate or spiral.
Length of leaves mostly exceeding ½ in.
Nerves several and the leaves somewhat striate.
Leaves elliptic to oblong, 2 to 4 in. long....7. *M. leucadendron.*
Leaves ovate or lanceolate, sharp-pointed, less than 1 in. long .....8. *M. styphelioides.*
Nerves solitary or obscure, the leaves very narrow and slender .....9. *M. armillaris.*
Length of leaves mostly ½ in. or less.
Calyx narrowed at base (ovoid): leaves linear, rigid, straight, about ½ in. long .....10. *M. parviflora.*
Calyx with broad flat base, partly embedded in stem at maturity.
Leaves ovate with broad base, rigid, scale-like, ¼ in. or less long .....11. *M. Huegelii.*
Leaves linear, slender, curved .....12. *M. ericifolia.*

B. Inflorescence a terminal globular head, the axis not growing out until after flowering (except in no. 16).
Stems and leaves glabrous or nearly so.
Flowers pink.
Leaves ¼ in. or more wide: capsules in a globose head .....13. *M. nesophila.*
Leaves ⅛ in. or less wide: capsules in a cylindric spike or scattered .....6. *M. decussata.*
Flowers white or yellowish.
Leaves rigid, straight, sharp-pointed .....14. *M. nodosa.*
Leaves lax, curved, scarcely acute .....12. *M. ericifolia.*
Stems or leaves white with a close tomentum.
Leaves about ¼ in. long .....15. *M. incana.*
Leaves minute (less than 1/16 in.), scale-like .....16. *M. micromeria.*

1. **M. hypericifolia** Sm.

A tall glabrous shrub: leaves opposite, lanceolate elliptic or narrowly oblong, acute or obtuse, ¾ to 1¾ in. long, ⅛ to over ½ in. wide, the midrib and numerous dots prominent beneath: flowering spikes of a rich red, 2 in. long and of the same diameter, forming the bases of leafy branches: stamens ¾ to 1 in. long, the claw about ½ in. long and splitting into about 20 filaments: capsule sessile by a broad base: seeds numerous. Illustration: Pl. 3, fig. 1.

One of the most showy species and very popular both for its gorgeous bloom and for the pleasing foliage. Easily mistaken for a Hypericum when not in flower.

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2. **M. fulgens** R. Br.

A tall shrub, glabrous throughout: epidermis of the bark peeling off in strips: leaves mostly opposite, from very narrowly linear to narrowly lanceolate, acute or obtuse, ½ to 1 in. long, the midrib very obscure, usually dark-dotted: flowering spikes of a rich dark red, rather loose and few-flowered: stamens often 1 in. or more long, the ribbon-like claw splitting into numerous filaments: capsule cup-shaped, sessile. Illustrations: Pl. 3, fig. 4; *Bot. Reg.*, pl. 103.

Perhaps not grown in California but long known in European gardens and certain to be introduced here.

3. **M. lateritia** Otto.

A graceful shrub with numerous slender branches, 6 to 10 ft. high: bark soft and corky, becoming fibrous: leaves alternate, overlapping, narrowly linear, acute, ½ to ¾ in. long, 1/16 in. wide, apparently nerveless: flowering spikes of a rich scarlet color, cylindric, about 2½ in. long and 1½ to 1¾ in. in diameter, forming the base of leafy branches: stamens ¾ in. long, very shortly united into clusters of 7 to 11 each: capsule with broad base somewhat embedded in the stem. Illustration: Pl. 3, fig. 2.

This is one of the most graceful of all the Melaleucas and with a much more pleasing color than any of the other red-flowered species, the shade being softer and not so harsh. Little known. Good examples may be seen at Elysian Park, Los Angeles, and at Soldiers Home.

4. **M. genistifolia** Sm.

A tall shrub (attaining 40 ft. in Australia), either glabrous or somewhat pubescent: leaves alternate, lanceolate or linear-lanceolate, rigid, acute, usually about ½ in. long, finely striate (at least the upper ones) with 7 or more nerves: flowering spikes loose, often leafy, and the axis usually growing out before the flowers expand: stamens about ¼ in. long, each claw with numerous filaments: capsule nearly globular, crowned by the persistent teeth.

Reported from California but not seen by me. In Australia a tea is made from the leaves.

5. **M. linariifolia** Sm.

A tall shrub (a large tree in Australia), the young parts a little pubescent, adult foliage glabrous and pale green: bark soft, shedding in large flakes: leaves opposite, rigid, linear, tapering to a sharp point, mostly 1 to 1¼ in. long, ⅛ in. wide, the midrib prominent beneath:

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flowers white (or lilac?), in pairs (this especially distinct in bud), in dense spikes of 1 to 1½ in. in length, these at first terminal but the axis finally grows out into a leafy branch: stamens ½ to ¾ in. long, the long claws emitting short filaments along their entire length: capsule ovoid-globular, narrowed at base. Illustrations: Pl. 3, fig. 3; Cav., *Icon.*, pl. 336 (poor).

Flourishes at Berkeley and at Los Angeles. A rare sort which should be widely cultivated for its trim habit, pale foliage, and usually pure-white flowers.

6. **M. decussata** R. Br.

A large spreading shrub, sometimes 20 ft. high, the branches commonly pendulous: bark shreddy: herbage bright green and glabrous throughout: leaves strictly opposite, elliptic oblong or lanceolate, acute or obtuse, narrowed to the base, ¼ to ½ in. long, nearly ⅛ in. wide: flowers lilac, the buds strictly opposite, the clusters cylindric, 1 in. or less long, the axis growing out as a leafy shoot, or the clusters globose and terminal or lateral when the flowers are sterile: stamens ¼ in. long, shortly united into bundles of 10 to 15 each: capsule partially embedded in the woody stem. Illustrations: Pl. 4, fig. 1; *Bot. Mag.*, pl. 2268.

Common in California gardens but suitable only for large grounds and parks.

7. **M. leucadendron** L. *M. cajaputi* Roxb. CAJUPUT TREE. PUNK TREE.

A large tree with thick spongy bark which peels off in layers, and pendulous branchlets, either entirely glabrous or the young shoots silky: leaves alternate, elliptic or oblong, tapering to each end, usually 2 to 4 in. long (rarely even 8 in.) and ½ to ¾ in. wide, with 3 to 7 parallel nerves and numerous cross-veinlets: flowering spikes creamy white (varying to pink and purple in Australia), 1½ to 4 in. long, 1 in. wide, at first terminal, the axis growing out only after flowering: stamens nearly ½ in. long. Illustrations: Pl. 4, fig. 3; Cav. *Icon.*, pl. 333 (as *Metrosideros quinquenervia*); Maiden, *Forest Fl. N. S. W.*, pl. 15; *Bot. Cook's First Voy.*, pl. 112.

This tree, which resembles some of the Acacias, is grown sparingly in Southern California. The largest specimen (about 20 years old) is at the Coronado Nurseries and measures 40 feet in height, the trunk is 14 inches in diameter, and the soft bark ¾ to 1½ inches thick. The wood is said to possess "a most beautiful combination of light and darker shades, which may be compared in appearance to ripple marks" (Maiden), and to be hard, heavy, close-grained, and imperishable underground. The

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tree withstands the effect of salt water by means of its thick, impervious bark. The leaves of certain forms yield cajuput oil, an article of commerce used in medicine.

8. **M. styphelioides** Sm.

Becoming a tall tree, with thick spongy bark; young shoots and inflorescence silky, the herbage otherwise glabrous: leaves alternate, ovate, sessile by a broad base, tapering above to a sharp rigid tip, usually more or less twisted, ⅝ in. long, nearly ¼ in. wide, striate with numerous fine nerves: flower-clusters creamy-white, dense, 1 or 2 in. long, nearly 1 in. wide, the axis growing out before flowering is over: stamens slightly exceeding ¼ in. in length: capsule globular, crowned by the persistent calyx-teeth. Illustration: Pl. 4, fig. 4.

Cultivated, so far as I know, only around San Diego but should be more generally used. The largest specimens are now large shrubs of neat appearance and with much clean, thrifty growth.

9. **M. armillaris** Sm.

A tall shrub, of graceful habit, glabrous throughout: bark gray, firm, furrowed, deciduous in narrow strips: leaves densely clothing the long slender twigs, alternate, narrowly linear, the tip very slender and usually curved outward, ½ to ¾ in. long, less than 1/16 in. wide: flower-clusters white, cylindric, over 2 in. long when well developed, ¾ in. wide, the axis protruding and leafy before the buds open: stamens ¼ in. long, the ribbon-like claw about as long as the free filaments: capsule with broad base partly embedded in the stem. Illustrations: Pl. 4, fig. 2; pl. 6; Cav. *Icon.*, pl. 335 (bad); *Bot. Cook's First Voy.*, p. 114.

This I consider the best of the white-flowered sorts. Especially suited to shrubberies and borders of broad walks where something graceful is desired. By means of a little heading in it may be made to assume a rounded form with many slender, drooping branchlets, each densely clothed with the abundant narrow foliage. This absence of barren twigs and of knotted fruit-clusters is one of its chief advantages. Specimens have grown to a height of 7 feet in two years at Santa Barbara, while shrubs 20 years old at Coronado are only 15 feet high. Much used at West Lake Park, Los Angeles, often as a shelter for the park benches. Does fully as well at San Mateo, San Francisco, etc., but perhaps of slower growth. Said to attain 20 to 30 feet in Australia. Often called *M. alba* in California gardens.

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10. **M. parviflora** Lindl. *M. Preissiana* Schau.

A tree or tall shrub, glabrous or the young parts pubescent: leaves alternate, thick, rigid, lanceolate or oblong-linear, sharp-pointed, ½ in. long or rather less, obscurely if at all nerved: flower-clusters white, loose, 1 in. or less long, capsule globose (narrowed to the base). Illustration: Pl. 5, fig. 1.

A hardy shrub, grown both in central and southern California, but much surpassed, as regards beauty, by other species. *M. armillaris* and *M. ericifolia* are often erroneously labeled *M. Preissiana* in California gardens; but this last name is only a synonym of *M. parviflora*.

11. **M. Huegelii** Endl.

An erect rigid shrub, 6 to 12 ft. high, with firm, pale bark, nearly glabrous: leaves alternate, spirally arranged and overlapping, strictly sessile, ovate, contracted above to a sharp point, ¼ in. or less long, striate with 3 to 7 nerves: flower-clusters white (the buds sometimes pink), dense, 1 to 5 in. long, about ¾ in. wide, the axis growing out before the buds open: stamens ⅜ in. long, the claw conspicuous and divided at the end into 7 to 11 filaments: capsules globular, crowded in a cylindric spike. Illustration: Pl. 5, fig. 5.

Frequent in southern California shrubberies where valuable chiefly because of its oddity. At Soldiers Home many of the branches fasciate, forming flat, leafy ribbons.

12. **M. ericifolia** Sm.

A large shrub or small tree, either glabrous or pubescent, the bark thick and soft: leaves alternate, not rigid, usually recurved from the middle, narrowly linear or nearly cylindric, rather obtuse, about ½ in. long: flowering spikes yellowish-white (there is a roseate variety in Australia), ½ to 1 in. long and ⅜ in. wide, the rachis soon growing out and leafy, or the flowers sometimes in nearly globular terminal heads (staminate): stamens ¼ in. long, the claws conspicuous and with about 7 filaments at the end: capsules truncate, in a dense spike. Illustration: Pl. 5, fig. 3.

A slender shrub resembling heath (Erica). Not much used in California. A few arboreous specimens may be seen on the lawns near the conservatory of Golden Gate Park, San Francisco.

13. **M. nesophila** F. Muell.

A glabrous shrub or small tree, attaining 35 ft. in California, with thick spongy bark which exfoliates in broad strips: leaves alternate, obovate-oblong, obtuse or with a sharp tip, thick, ½ to 1 in. long, about

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¼ in. wide, obscurely 1- or 3-nerved: flowers pink or rose-color, in dense terminal heads 1 in. or more in diameter, the axis seldom growing out before flowering is over: claw of the stamens short: capsules smooth, congested in a globose or ovoid mass. Illustration: Pl. 5, fig. 4.

Suitable for parks and other large grounds. A very rapid grower and makes a fair shade, but the capsules, which form knot-like excrescences on the exposed branches, are objectionable.

14. **M. nodosa** Sm.

A tall nearly glabrous shrub: leaves linear or subulate, rigid, straight and rigidly sharp-pointed, ½ to ¾ or 1 in. long: flowers pale yellow, in numerous dense globular clusters which are scarcely ½ in. in diameter, the axis not growing out until after flowering: capsules in small compact heads scarcely more than ¼ in. across. Illustrations: Pl. 5, fig. 2; Cav. *Icon.*, pl. 334; *Bot. Cook's First Voy.*, pl. 115.

Rare in cultivation. Grown in Golden Gate Park.

15. **M. incana** R. Br.

A tall shrub, the young twigs and flowering branches ashy with a fine close pubescence: leaves alternate or sometimes opposite, spreading, linear to lanceolate, acute, ¼ to ½ in. long, hoary with white hairs at least when young, mostly 1-nerved: flowers yellowish white, in dense terminal ovoid or oblong spikes about ¾ in. wide, the axis rarely growing out until after flowering: stamens shortly united in bundles of 3 to 9: capsules in dense cylindrical spikes ¾ to 1 in. long. Illustrations: Fig. 14; *Bot. Reg.*, pl. 410.

Fig. 14.—*Melaleuca incana.*

Reported as growing in Golden Gate Park. A beautiful specimen with pendant twigs may be seen in the "Arizona Garden," on the Hotel del Monte grounds, Monterey.

16. **M. micromeria** Schau.

A tall shrub with many short slender branches, covered by a short close white tomentum which is often concealed by the minute foliage: leaves exceedingly minute, mostly in whorls of 3, closely appressed to the stem, ovate, scale-like: flowers in small globular heads about ¼ in. in diameter: capsules in dense clusters less than ½ in. across.

Once grown at Santa Barbara by Dr. Franceschi but probably no longer in cultivation in California.

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LEPTOSPERMUM.

This is a genus of shrubs and small trees, with small, entire, alternate leaves and mostly white flowers on short lateral branches. All of our species are from Australia except *L. ericoides,* which is a native of New Zealand, and *L. scoparium,* which occurs both in Australia and New Zealand.

The only one to be recommended for general planting is the well known *L. laevigatum,* the others being in no way superior and of value chiefly as novelties. This species, however, grows rapidly and soon makes a spreading shrub 8 to 12 feet high, which is laden during the spring months with a profusion of white bloom. It is particularly adapted to mass planting in large parks and for filling in unsightly corners. Because of its drought resistant properties and its rapid growth, it should be experimented with as a shrub for reforesting purposes in our foothill districts. In case a larger plant is desired, *L. fabricia* may be used, since it is reported as becoming quite arboreous in Australia. *L. flavescens* is much grown in Europe and its var. *grandiflorum* has flowers of the largest. *L. scoparium* is a shrub, rarely attaining 12 feet. When the leaves are exceedingly narrow it is called *L. juniperinum.* Its flowers are sometimes pink or even red. *L. ericoides* is one of the "tea trees" of New Zealand, sometimes growing to a height of 40 to 60 feet, with a trunk sufficiently large to be used for piling, fence posts, etc., and would probably grow without care on our lower hills.

Propagation is effected by use of the seeds although these are not always fertile. Cuttings from young wood are more satisfactory and are grown under glass. All of the species are hardy for California and endure drought well.

Key to the cultivated Species of Leptospermum.

A. Ovary and capsule 6- to 10-celled: fertile seeds rather broadly winged.

Calyx glabrous: leaves broad, obtuse, ½ to 1 in. long: flowers large ..... 1. *L. laevigatum* Muell.

Calyx villous: otherwise similar ..... 2. *L. fabricia* Benth.

B. Ovary 5-celled: seeds linear.

Calyx glabrous.

Leaves obtuse, ¼ to ¾ in. long: flowers of medium size ..... 3. *L. flavescens* Sm.

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Leaves acute, narrow.
Flowers ⅛ to ¾ in. across: leaves with rigid tips ..... 4. *L. scoparium* Forst.
Flowers ¼ in. across: leaves small, dense, heath-like, the tips not rigid ..... 5. *L. ericoides* A. Rich.
Calyx pubescent with long hairs.
Calyx broad and obtuse at the base, villous with long hairs: leaves linear, or elliptic, or obovate, obtuse or with a short sharp tip ..... 6. *L. lanigerum* Sm.
Calyx attenuate at the base (at least when young), silky with appressed hairs: leaves small, obovate or oblong ..... 7. *L. myrtifolium* Sieb.

Since only one or two species of Leptospermum are grown in California to any considerable extent, the detailed botanical descriptions are omitted.

AGONIS.

One species of Agonis is grown in California, namely *A. flexuosa* Schau., of which good examples may be seen in Golden Gate Park and at Soldiers Home, near Los Angeles. The shrub is commonly mistaken for a Leptospermum but is much more graceful in habit and with longer, more slender leaves. Very serviceable where a pendant effect is desired rather than a show of bloom.

METROSIDEROS.

This genus includes two magnificent New Zealand trees, grown in California to a limited extent. They may be known by their large size, the thick and leathery strictly opposite leaves, and the rounded, terminal flower-clusters rendered brilliant by the profusion of long-exserted, crimson stamens. In *M. robusta* A. Cunn. the leaves are glabrous and 1 to 1½ inches long; in *M. tomentosa* A. Rich. they are usually clothed beneath with white hairs and are mostly 2 to 4 inches long.

Metrosideros may be used either as an ornamental shrub or as an avenue tree. It is easily propagated by means of cuttings since it is disposed to throw out roots, even on the main branches. In New Zealand "it commonly commences life as an epiphyte, in the upper branches of some tall forest tree, sending to the ground aerial roots which coalesce and form a trunk after the death of the supporting plant" (Cheeseman).

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These trees are not hardy, and although grown at San Francisco will not endure a temperature much below the freezing point.

Several species of Callistemon are known in trade as Metrosideros. The so-called *M. semperflorens* and *M. latifolius* are mostly *Callistemon lanceolatus*. *M. speciosus* is *Callistemon speciosus*.

CALOTHAMNUS.

Although often confused with Melaleuca, this genus is at once distinguished by the anthers, which are erect and attached by the very base to the summit of the filament. Our only common species in cultivation is *C. quadrifidus* R. Br., of Australia, a low shrub with cylindric, punctate leaves and clustered crimson flowers with long stamens united into bundles. Its uses and methods of propagation are similar to those given for Callistemon.

MISCELLANEOUS ORNAMENTALS.

Lyonothamnus floribundus var. **asplenifolius** Brandegee.

ISLAND IRONWOOD.

An erect, evergreen tree, becoming 75 ft. high, with very heavy and dark wood and a loose red bark which exfoliates in long ribbon-like strips: leaves fern-like, opposite, stalked, mostly parted into several narrowly oblong or lanceolate segments, each segment 3 or 4 in. long and cut to near the midrib into many shield-shaped lobes (mostly simple and nearly entire in typical *L. floribundus*), white-tomentose beneath or glabrous: flowers white, small, but the clusters dense and 4 to 8 in. across: sepals and petals 5 each: stamens 15: pistils 2, distinct: seeds usually 4, minute. Family Rosaceae. Santa Barbara Islands. Illustrations: Fig. 15; pl. 7; *Zoe*, i, pl. 5; Sudworth, *Forest Trees Pacif. Slope*, figs. 154, 155; Sargent, *Silva*, pl. 197; Sargent, *Man. Trees N. A.*, fig. 275.

Lyonothamnus is, in many respects, the most remarkable contribution that California has made to the world's list of ornamental trees. It is known native only on Santa Cruz, Santa Rosa, Santa Catalina, and San Clemente islands, and was first brought to the mainland in 1894 by Dr. Franceschi, of Santa Barbara. In that year one live stump and a quantity of seeds were procured on Santa Cruz Island. The former was planted on State street, Santa Barbara, where it produced a tree about

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35 feet high in 16 years. Several plants were obtained from the seed. At least two of these (one on the Gillespie grounds, Montecito, one at the Cooper Ranch, Elwood) bloomed when 13 years old. Another tree of this same generation is growing vigorously on the University Campus at Berkeley and now, at 15 years of age, is in bloom for the first time. It measures 45

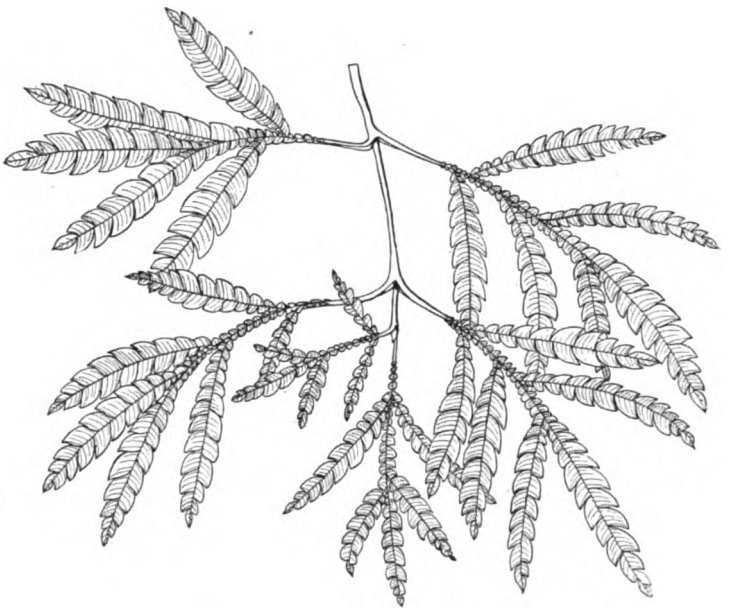

Fig. 15.—*Lyonothamnus floribundus.*

feet high, and has a trunk diameter of 10 inches. Because of its beauty and symmetry, as well as its botanical interest, it is justly considered the pride of the garden.

The ornamental uses which can be made of this tree are numerous. It harmonizes well with almost any combination of surroundings, but is not adapted to small grounds. The tall, stately habit adds dignity to any environment, while the dense and gracefully drooping foliage forbids any suggestion of rigidity or coldness, and when covered with the copious white bloom the tree is certainly a pleasing sight. As a specimen tree for large grounds, parks, and the like it is unexcelled, particularly

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if plenty of room is given it, in order that there may be a symmetrical development and that the general outline may be brought out.

Lyonothamnus is especially recommended as an avenue tree. The erect habit of growth, moderate spread, and narrow crown, would combine with the graceful foliage in making an avenue of these trees one of the most dignified and pleasing drives in the state. It is hoped that the supply will soon be sufficiently adequate to warrant their utilization for this purpose.

Objection has been made to it as a lawn tree because of the litter produced, but healthy trees cast no appreciable amount of litter. When grown on lawns, the ground directly under the tree should be cultivated. The only further objection that I have heard is that it harbors black scale, this reason being given for its scarcity at Los Angeles. This objection, however, is not a serious one, since black scale is now readily held in check by certain animal parasites. Trees at Santa Barbara and at Berkeley are not infested with scale to any noticeable extent.

Concerning the conditions under which Lyonothamnus may be expected to thrive, we can only say that, so far as tried, there have been no failures. These trials have been mostly in the coast districts. The interior may be too dry for its best development, but this point has not yet been tested. Perhaps the best specimen in cultivation is the one on the Reed grounds at Pasadena, where the summers are quite warm and dry. Its hardiness is likewise unknown, but temperatures of 25° F. have not affected the foliage whatever.

In its natural habitat, Lyonothamnus grows on well drained soil which is moderately moist. The groves, so far as I have observed, are always on north slopes, but neither in cañon bottoms nor on the wind-swept ridges. These groves are of very limited size, mostly covering less than an acre of land, and of limited number. Seedlings, moreover, are entirely wanting, all of the trees being apparently second growth, that is, suckers from old stumps. Even where the old stumps are not found, the trees are frequently arranged in an irregular circle, the center of which was perhaps once occupied by the parent tree. Only a very small percentage of the seeds are fertile and nurserymen

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who have propagated them have had much difficulty because of the readiness with which the young seedlings damped off. All of these facts, together with the isolation of the genus from all related forms, seem to indicate that we have here a decadent race, marooned on these few islands where its last stand in the fight for existence is being made.

That this race of trees will become extinct unless protected is a certainty. Steps should be taken, either by the State or Federal Government, to acquire and protect at least a few of the groves. An important factor in the weakening of this race is doubtless that of inbreeding. There are apparently no special devices for cross pollination and, judging from the botanical characters of the two forms, there is almost certainly no transfer of pollen from one island to another. If artificial cross pollination were practiced between the typical form and the var. *asplenifolius,* a good yield of fertile seed would probably result and give rise to a stronger race. At least, the experiment should be made.

Propagation is best effected by seed. These are largely infertile, so that only a small percentage can be expected to germinate. In the past, this seed has all come from Santa Cruz Island, but cultivated trees at Santa Barbara are now yielding a more convenient supply. In propagating from seed, great care must be exercised to see that the seedlings do not damp off in the early stages. Stumps have been successfully transplanted but their shipment from the islands is expensive. They may be divided by splitting, but experience has shown this to be a precarious proceeding. All attempts at layering and propagation by means of cuttings have failed up to the present time.

Eugenia myrtifolia Sims.[2]

Australian Brush Cherry.

An evergreen glabrous tree, or shrub-like: leaves opposite, oval or oblong, narrowed to each end, short-stalked, mostly acute, entire, 1½ to 3 in. long: flowers in loose clusters: calyx-tube top-shaped, the lobes

[2] Some confusion has arisen because of the various names applied to this tree. *Eugenia australis* Wendl. is exactly the same, according to best authorities. *Jambos myrtifolia* Nadz. is the name adopted in Engler and Prantl's *Natürlichenpflanzenfamilien.*

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unequal: petals 4, white, ¼ in. across: stamens numerous: ovary inferior: style single: fruit red, ovoid, nearly 1 in. long, fleshy, of a pleasing acid taste. Family Myrtaceae. Australia. Illustrations: Pl. 8; *Bot. Mag.*, pl. 2230.

This tree may be used as a hedge plant, as a shrub for the lawn or garden, as a specimen tree for large grounds, or as a street tree, and is perhaps the best of the whole list for general planting. The habit is dignified, yet graceful and pleasing. Its leaves are plentiful, clean, glossy, and green. It prunes well, and so may be molded to harmonize with its surroundings. Eugenia is hardy for all of the coast district of California, grows well as far north as Sacramento (and there is no reason why it should not be used much beyond this latitude), and in the interior at least as far as Redlands.

When it is desired to form a tall, narrow hedge, the plants should be set close together. If a shrub is desired, the growth of several central stems should be encouraged and the head cut back. Even so it will insist on becoming a tree in favorable localities, in which case it will be necessary to resort to root pruning.

Growth is not rapid, although one specimen at Coronado attained a height of 40 feet in 20 years. At Santa Barbara a tree 80 feet high was observed, but the age is not known. On the San Francisco Peninsula it is commonly grown in masses and therefore remains low. A good example, 20 feet high, may be seen on the Capitol grounds at Sacramento.

As a street tree, *Eugenia myrtifolia* would almost certainly be a splendid success. The difficulty of procuring a large supply of trees has prevented its use for this purpose, but they are now sufficiently plentiful to warrant its adoption for some of our more progressive cities.

Propagation is easily accomplished from seeds, but these are not to be had in large quantities. Cuttings taken from firm or partially ripened wood strike without difficulty.

Macadamia ternifolia F. Muell.

AUSTRALIAN NUT.

A slender glabrous tree, becoming 50 ft. high: leaves in whorls of 3 or 4, or the upper ones more scattered, oblong or lanceolate, acutish,

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short-stalked or sessile, serrate with remote sharp slender teeth or entire, several inches to 1 ft. or more long: flowers small, in long racemes, growing in pairs on short stalks: ovary simple, developing into a hard-shelled ovoid nut with a leathery covering. Family Proteaceae. Australia.

Valuable chiefly because of its nuts, this tree also deserves consideration as an ornamental. It is a clean, straight-growing, pleasing tree, without objectionable features, and is suggested as a specimen tree for parks and large gardens and also as a nut tree, both for commercial plantations and for the home orchard.

Specimens are growing at San Francisco and Berkeley, but none of these have yet blossomed, so far as I am aware. This may be due to excessive shading or crowding or to unfavorable soil conditions. At Santa Barbara we find several splendid trees. One of these, now about five years old, is 15 feet high and bearing nuts, although it has had no attention. Another, on the Gillespie grounds at Montecito, is eleven years old and has borne several crops. This tree, although on poor soil and much crowded, is now about 50 feet high and still growing. Some of its branches are 10 feet long, the lower ones sweeping the ground, the shorter upper ones ascending, the whole appearance being that of a thrifty, well established specimen, a credit to any garden.

The flowers appear in December and the blooming period extends into March, the nuts ripening the next autumn. These nuts are borne in long, pendant racemes of 6 to 24 nuts each. Only the larger ones are fertile and the extremely hard shell renders the cracking of the nuts a difficult operation. They resemble filberts somewhat in appearance and taste but are said to excel all other nuts in flavor and to sell in the English market at $2.50 per pound. In Australia the price averages $1.25 per pound, when sold for propagation purposes. Australian writers inform us, further, that the trees are there planted 20 feet apart, attain a height of 50 feet, come into bearing when seven years old, and yield 3 to 14 nuts to each raceme. It would seem that some parts of California are fully as well adapted to the tree as any part of Australia, where the production of its nuts is considered to be very remunerative.

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Maytenus Boaria Mol.

MAYTEN.

A glabrous evergreen tree of graceful habit, 15 to 40 ft. high or more, the crown broad and spreading, the slender branchlets pendant: leaves alternate, lanceolate, much narrowed to each end, finely and evenly serrate, 1 to 1½ in. long: flowers small, greenish, in small clusters along the leafy branchlets, the staminate with calyx-teeth petals and stamens 5 each: capsule splitting into 2 widely spreading valves: seeds with a scarlet aril. Synonym: *M. chilensis* DC. Family Celastraceae. Chile, northern Patagonia, etc. Illustrations: Pl. 9; *Bot. Reg.*, xx, pl. 1702; Bailey, fig. 1382.

The Chilean Mayten may now be seen at a number of places in California, and is becoming more and more a favorite. Its chief claims for consideration are its graceful habit and delicate smilax-like foliage. Because of the rounded top, pendant twigs, and modest color, it harmonizes well with other shrubs and trees, except those of a rigid, pyramidal habit. The twigs have been used for interior decoration with good results, and when woven into the meshes of a large net the effect is very suggestive of a bank of smilax.

This tree endures pruning well and when the lower branches are removed makes a fair shade tree, where the densest of shade is not desired. It is well adapted to lawn planting and is most beautiful when the branches are allowed to sweep the sward. Being a slow grower it is well adapted to places where tall trees are objectionable, and by occasionally removing the top-most growths, it may be kept as a shrub for 10 or 15 years. A lawn specimen in Berkeley has grown to a height of 15 feet in 7 years, while trees about 20 years old are 30 to 35 feet high. At Pasadena one of these plants grew 12 feet in 3 years.

Although seldom seen as a street tree, there is little doubt that the Mayten will prove itself useful for this purpose on rather wide streets where evergreens are desired. It will need attention, however, to prevent the central shaft from dividing into several branches. All but one of these should be removed as soon as formed.

The Mayten flourishes equally well in middle and in Southern California, along the coast and in the interior. It is propagated from cuttings taken in the fall, or from seed. Volunteer

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seedlings are not uncommon under old trees and root-suckers also appear in some cases.

Roupala Pohlii Meisn.

ROUPALA.

A tall narrow evergreen tree with smooth gray and somewhat mottled bark, the young shoots and leaves rusty with numerous woolly hairs, the mature foliage glabrous, glossy and dark green: leaves compound, 1 ft. or more long; leaflets 5 to 8 pairs, short-stalked, ovate, acuminate, oblique at base, 4 or 5 in. long, about 2 in. broad, coarsely toothed: flowers yellowish, in erect racemes which are 3 to 5 in. long: perianth with 4 narrow lobes: ovary and style single: fruit a hard 2-valved capsule. Synonym: *R. corcovadensis* Hort. Family Proteaceae. Brazil. Illustration: *Bot. Mag.*, pl. 6095.

Of the three or four specimens in California of this strikingly handsome plant, the finest is perhaps the tree on the Gillespie place at Montecito, near Santa Barbara. This is now 13 years old, but was once broken off by the wind; the present height of 30 feet represents the growth of about 7 years.

The foliage of this tree is unlike that of any other and constitutes its chief charm. The long, compound leaves curve gracefully outward, many of them becoming pendant, and thus the tree is clothed with a shining mantle of green. The young shoots, bronzed throughout with a soft, rusty tomentum, add color to the foliage during the spring months.

Roupala is a tree for only a few gardens, being somewhat sensitive to frost and easily broken by winds. A warm, sheltered place should therefore be chosen. It is, moreover, difficult to procure. Experiments with cuttings have so far failed and seeds can be had only by importation from Brazil. Further trials with cuttings should be made, since this method is apparently successful in England, the cuttings being "inserted in sand, under glass, with bottom heat" (Nicholson).

Choisya ternata HBK.

CHOISYA.

A compact free-blooming bush, 3 to 5 ft. high (said to reach 10 ft. when trained against warm walls), the young parts minutely hairy: leaves opposite, compound, the common petiole ½ to 2 in. long; leaflets

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3, narrowly obovate, obtuse, tapering to a sessile base, entire, 1½ to 2½ in. long, marked with minute oil-dots: flowers white, ¾ in. across, in forking terminal clusters: sepals and petals 5 each: stamens 10: pistil solitary. Family Rutaceae. Mexico. Illustrations: Pl. 10; HBK. *Nov. Gen. et Sp.*, pl. 513.

Choisya ternata is perhaps the most desirable small shrub now grown in California, one which has been thoroughly tested in a variety of situations, and yet it is scarcely known outside of a few parks and a limited number of private gardens. It is exceedingly neat and trim in appearance, round-topped, and the leaves are of that smooth, glossy texture which easily sheds dust and keeps clean even through a long, dry summer. The blossoms, comparable to those of the orange but scarcely fragrant, occur in abundance, five or six "crops" appearing each year, at least when grown in warm situations near the sea. The flowers appear in greatest abundance, however, during the early spring months. Although a native of Mexico, it grows only at considerable altitudes in that republic, and flourishes in California both along the coast and in the interior, from San Diego to San Francisco, and would undoubtedly do well much farther north. It has been known to endure a minimum temperature of 10° F.

Choisya is recommended for small lawns and yards, especially for city lots and for interior courts. In Golden Gate Park, San Francisco, it is used to good effect in masses, one planting of some 200 specimens being especially pleasing when in full bloom. This shrub is said to be grown in England as a hedge plant, such hedges being as broad as high, round-topped, and quite satisfactory whether in flower or only in foliage.

Propagation is by means of cuttings taken between the periods of bloom. Fertile seeds rarely form on cultivated plants, and their importation is impracticable. Choisya was first described from cultivated plants whose exact origin was unknown. It has since been discovered in the vicinity of San Luis Tultitlanapa, near Oaxaca, and elsewhere in Mexico.

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Streptosolen Jamesonii Miers.

STREPTOSOLEN.

An evergreen rough-pubescent shrub, usually 3 to 6 ft. high: leaves short-stalked, oval, narrowed to each end, entire, ¾ to 1½ in. long: flowers showy, rich orange, in loose terminal clusters: calyx tubular, 5-toothed: corolla tubular-campanulate, 5-lobed, 1 in. long, ½ to ¾ in. wide across the expanded limb, the tube twisted below: perfect stamens 4: capsule 4-lobed. Synonym: *Browallia Jamesonii* Hort. Family Solanaceae. U. S. of Columbia. Illustrations: *Bot. Mag.*, pl. 4605; Bailey, fig. 2436.

Commonly grown as a flowering shrub, Streptosolen is equally satisfactory when trained against walls or on a trellis, since in habit it is half-climbing. Left to itself it spreads out into irregular but graceful masses 15 or 20 feet across and 4 to 6 feet high; if taken in hand when young and carefully pruned it may be made to assume an upright form with a more or less distinct trunk, and has been trained on walls to heights of 10 feet or more. Whatever the habit, it blooms profusely at all seasons and is especially adapted to situations calling for masses of color during the winter months. Partial shade does not seem to discourage this shrub, for in San Mateo County I have seen it blooming profusely beneath oak trees in April. A light soil is necessary for its best development. It is therefore recommended for almost any situation where the color harmonizes with its surroundings and where the temperature does not fall much below the freezing point. It might well replace much of the Lantana so commonly grown in California.

It must be remembered, however, that Streptosolen is a tender plant. It sometimes freezes in the San Francisco Bay district, but only when grown on low ground. In the coastal region from San Luis Obispo south it is perfectly safe except in the coldest situations. It is used as far inland as Redlands, but at that place it is necessary to select warm situations.

Cuttings grow readily and afford a very satisfactory method of propagation. In England cuttings are struck in the spring and grown in 10-inch pots without pinching, the result being tall plants for the greenhouse, clothed with fine trusses of bloom during the winter months. (See further in *Gardeners' Chronicle*, ser. 3, xxxi, 84 and xxxvii, 375.)

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Solanum Rantonnetii Carr.

BLUE-FLOWERED SOLANUM.

An erect bushy plant, 4 to 10 ft. high, or may be trained as a vine to 15 ft.: leaves soft with microscopic hairs, alternate, lanceolate, narrowed to each end, entire, very variable in size: flowers slender-stalked, violet-blue, nearly 1 in. across: calyx 5-toothed: corolla rotate, 5-angled: stamens 5, attached to the corolla, the anthers oblong and connivent: fruit a 2-celled berry, red, drooping, very ornamental, many-seeded. Family Solanaceae. Paraguay and Argentine. Illustration: Pl. 11, fig. 1.

This plant, which may be considered either as a shrub or as a vine, depending upon the method of pruning, is being successfully grown in a number of southern California gardens. It is recommended for situations where a mass of blue color is desired at all seasons of the year, since it is a continuous as well as a profuse bloomer, the flowers forming in clusters over nearly all the exposed area.

The growth is rapid and a single vine has been known to make an almost solid wall 15 feet long by 12 feet high. Its effectiveness is increased by planting with it some yellow-flowered vine.

When treated as a shrub, *Solanum Rantonnetii* produces a solid mass of foliage and many flowers. For this purpose the lower branches should be pruned back and the whole plant headed in occasionally. Only moderate irrigation is to be practiced if an abundance of bloom is desired, since ordinary watering, such as is given to most shrubs, has a tendency to check its flowering proclivities. It is eminently adapted to dry situations.

Propagation is easily accomplished by means of cuttings. It also comes readily from seed.

Other species of Solanum are better known in cultivation. *S. jasminoides*, often called "potato vine," is the most popular. It is noted for its large clusters of white flowers, but sometimes has a tendency to cast its leaves and thus become ragged or twiggy.

Buddleia madagascariensis Lam.

MADAGASCAR BUDDLEIA.

A loose straggling shrub (but easily controlled by pruning), becoming 15 to 20 ft. high, the stems petioles pedicels and under surface of the

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leaves clothed with a dense rusty tomentum: leaves green above, opposite, ovate-lanceolate, acuminate, tapering or rounded to short stalks, entire or nearly so, often 6 in. long: flowers fragrant, of a yellowish orange color, borne in long slender trusses which are frequently pendant: calyx shortly 4-toothed: corolla funnel-shaped, the tube about ¼ in. long, cottony, the 4 lobes short and roundish: stamens 4, inserted at the mouth of the corolla-tube: style single, as long as the stamens: berries of a beautiful translucent blue color. Family Loganiaceae. Madagascar. Illustrations: *Bot. Reg.*, xv, pl. 1259; *Bot. Mag.*, pl. 2824.

This Buddleia is cultivated only to a limited extent in California, where it was first introduced by Dr. Franceschi, of Santa Barbara. It may be either trained into an erect, bushy form, or allowed to clamber over other plants, rockeries, or unsightly objects. As a matter of fact, this latter is perhaps its most important use, since it is too coarse for ordinary "front-yard" planting and the old flowers, drying to a disagreeable brown, persist long after they have ceased to be ornamental. For certain positions, however, such as filling up odd corners, covering an unsightly water-tank or shed, etc., nothing is more satisfactory.

It is most effective when trained up so that the branches clear the ground; the rounded tops when properly supported may then attain a height of 20 feet and give a spread fully as great.

The growth is rapid and the long, drooping branches, densely clothed with the ashy-gray leaves, present a pleasing sight, to which is added, during the spring and summer months, the brilliancy of the yellow flowers borne profusely in long panicles. These are followed in autumn by the blue berries. The plant is perfectly hardy throughout western California.

Three other species of Buddleia are cultivated in California. The more common of these is *B. globosa*, a low bush with yellow flowers in globular heads. It is a serviceable bedding plant, much used throughout the state and easily grown, but with no special features to commend it. (See *Bot. Mag.*, pl. 174.)

B. Lindleyana is less generally known but has the most beautiful flowers of all. They are of a royal purple color and velvety on the inner surface, in long racemes or panicles, the lower ones dropping off as new buds open. Leaves green on both sides. Half deciduous but hardy and should be freely used. (See *Bot. Reg.*, xxxii, pl. 4.)

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B. variabilis may be known by its coarsely serrate leaves, white-cottony beneath, and by the glabrous corolla, which is lilac with an orange-yellow mouth. Rare in California but grown at Goleta and Hollywood. Hardy and a very desirable sort. The var. *Veitchiana* is said to be superior even to the typical form. (See *Bot. Mag.*, pl. 7609.)

The propagation of Buddleias is best carried out by the use of cuttings. This is particularly important if it is desired to exactly reproduce any special form. Such a case is a strain of *B. madagascariensis* which has yellow tomentum and more flowers than the ordinary sort, but does not come true to seed. When trimmed back they branch freely and put out numerous shoots. *B. globosa* is almost weed-like in this respect and sprouts up even if cut back to the root.

Acokanthera spectabilis Benth.

WINTERSWEET.

A trim erect shrub of columnar habit, 4 to 6 ft. high, glabrous almost throughout: leaves leathery, shining above, opposite or alternate, elliptic or broadly lanceolate, very acute, short-stalked, entire, 3 or 4 in. long: flowers jasmine-scented, white tinged with rose or suffused with pink, in dense terminal and axillary clusters, withering-persistent: calyx short, 5-cleft: corolla minutely pubescent without, slenderly tubular, about 1 in. long, the limb parted into 5 lanceolate or ovate lobes: stamens and style included: fruit berry-like, nearly black, the size of a plum. Synonym: *Toxicophlaea spectabilis.* Family Apocynaceae. South Africa. Illustration: *Bot. Mag.*, pl. 6359.

In this shrub we find a true aristocrat. It carries itself with pride and dignity, and like many another exotic which, in the eastern states, demands the solicitude of hot-house culture, is easily grown in southern California as a yard-plant.

Because of its moderate size and slender habit, the Wintersweet is eminently adapted to small yards and lawns. It can be used to good effect in formal planting, either singly or in rows. For this purpose it is much more effective than the European Bay so often used.

Commonly clothed with a rather dense foliage, it is found that in some situations this shrub has a tendency to cast many of its leaves. In this case the twiggy appearance may be rem-

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edied by pruning back, thus inducing a growth of new foliage. The flowers are neat and pretty but are withering-persistent. If one is not content to wait a few weeks for them to fall they may easily be plucked by hand (since they grow in clusters) or knocked off with a rake. The fruit is presumably poisonous but it is also exceedingly bitter, so that there is no danger of its being eaten by children or domestic animals. The bark is well known to yield a virulent poison.

The minimum temperature which this plant will endure has not been definitely determined, but it is probably not far below the freezing point. It passes safely through the winters at Santa Barbara and Los Angeles and should be tried on a small scale farther inland and in middle California. It is indifferent to neglect and lack of irrigation.

Propagation is readily effected by seeds. Cuttings are rooted without difficulty.

Feijoa Sellowiana Berg.

FEIJOA.

An erect shrub or small tree, with brown bark: leaves opposite, thick, 2 or 3 in. long and half as broad, oblong, obtuse, short-stemmed, deep green and shining above, white-tomentose beneath: flowers solitary, axillary, 1½ or 2 in. broad, the flower-stalk 1 in. long: calyx-lobes orbicular, reflexed: petals 5, orbicular, spreading, internally blood-red with white margins: stamens numerous, red, the anthers yellow: ovary inferior, 4-celled: fruit oblong, 2 in. long, many-seeded, yellowish green, fleshy, very aromatic. Family Myrtaceae. Southern Brazil, Uruguay, etc. Illustrations: Pl. 11, fig. 2; *Bot. Mag.*, pl. 7620; *Gard. Chron.*, ser. 3, xxiv, fig. 134.

In speaking of ornamental shrubs for California, mention should perhaps be made of this South American fruit, since it is highly ornamental as well as useful. This is not the place to speak of its economic features, but those who are interested in the introduction of new, high-class, money-making fruits, will do well to give attention to the Feijoa, which is certain to become very popular.

The beauty of this shrub lies in its foliage and flowers. The green upper surface of the leaves contrasts finely with the white lower surface, and the parti-colored flowers are strikingly handsome and unusual both in color and form.

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Feijoa is much more hardy than the orange, and so may be grown in most of the settled portions of our state. It is not particular as to soil and apparently endures a moderate amount of drought. (See further account in *Pacific Garden* for June, 1908, and for July, 1909.)

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PLATE 1.

Pittosporum phillyraeoides DC. NARROW-LEAVED PITTOSPORUM.

A tree grown at Santa Barbara, California, in a neglected corner. The pendant habit is characteristic and the leaves persistent. Flowers yellowish, inconspicuous.

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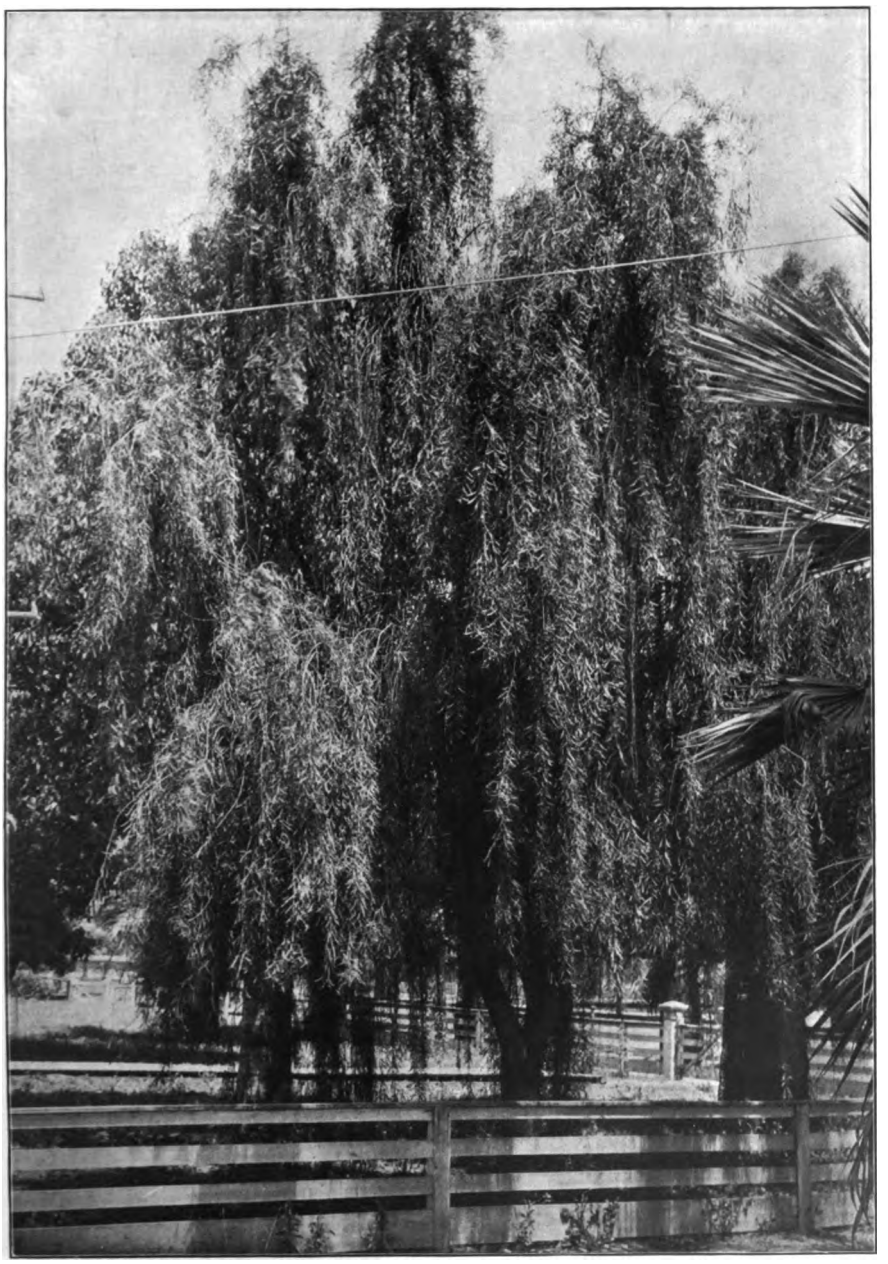

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PLATE 2.

Callistemon speciosus DC.

A tree growing in Santa Barbara, California. About twenty years old, forty feet high. Usually only a bush in California. Flower-clusters bright red, large, pendant.

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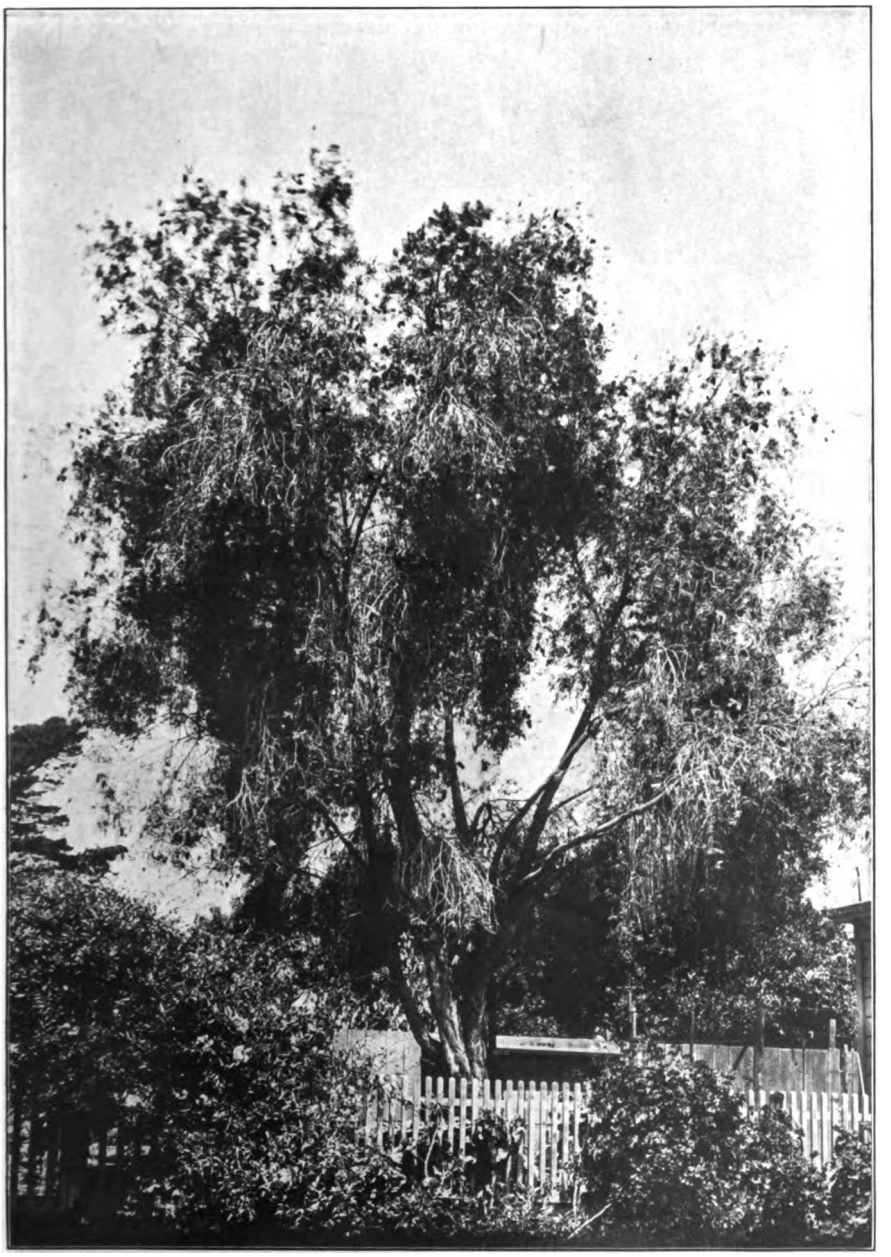

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PLATE 5.

1. **Melaleuca parviflora** Lindl.

a. Flowering branch. (A little more than natural size.)

b. Section of the stem with basal portion of three leaves. (Enlarged.)

c. Single flower. (Enlarged.)

d. Stem with young capsules and a few persistent leaves. (Enlarged.)

e. Old capsules on a stem from which all of the leaves have fallen. (Enlarged.)

2. **Melaleuca nodosa** Sm.

a. Flowering branch with capsules of the previous year at the base. (Natural size.)

b. Single flower. (Enlarged.)

c. Cluster of six stamens. (Enlarged.)

d. Leaf, showing the oil-dots. (Enlarged.)

3. **Melaleuca ericifolia** Sm.

a. Branch, showing capsules of the year on the upper portion, and a cluster of older capsules below. (Natural size.)

b. Capsule seen from above. (Enlarged.)

4. **Melaleuca nesophila** F. Muell.

a. Flowering branch with a cluster of capsules of the previous year at the base. (Reduced to three-fourths natural size.)

b. Fascicle of nine stamens. (Enlarged.)

5. **Melaleuca Huegelii** Endl.

a. Flowering branch with some unopened buds above, and a spike of buds to the right. (About one-half natural size.)

b. Flower. (Enlarged.)

c. Portion of stem showing the appressed leaves. (Enlarged.)

d. Old capsules massed about the stem. (Reduced.)

e. Three capsules. (Enlarged.)

All of the figures drawn by Mrs. Louise Nash.

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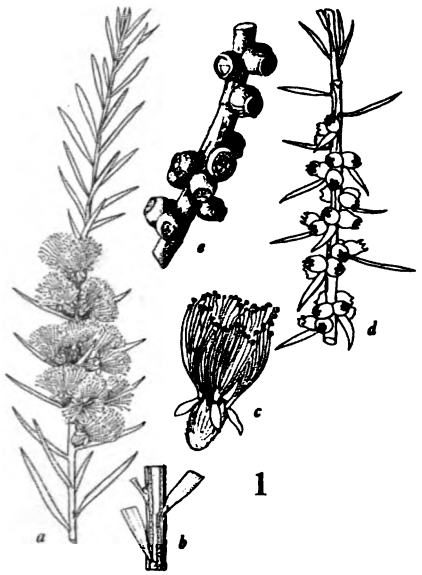

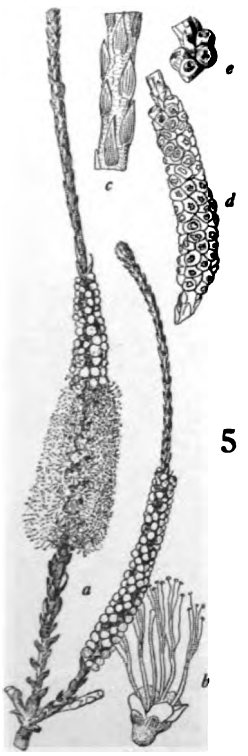

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PLATE 6.

Melaleuca armillaris Sm.

A vigorous specimen seven feet high, only two years old, bearing many pendant clusters of white flowers. Grown in Santa Barbara, California.

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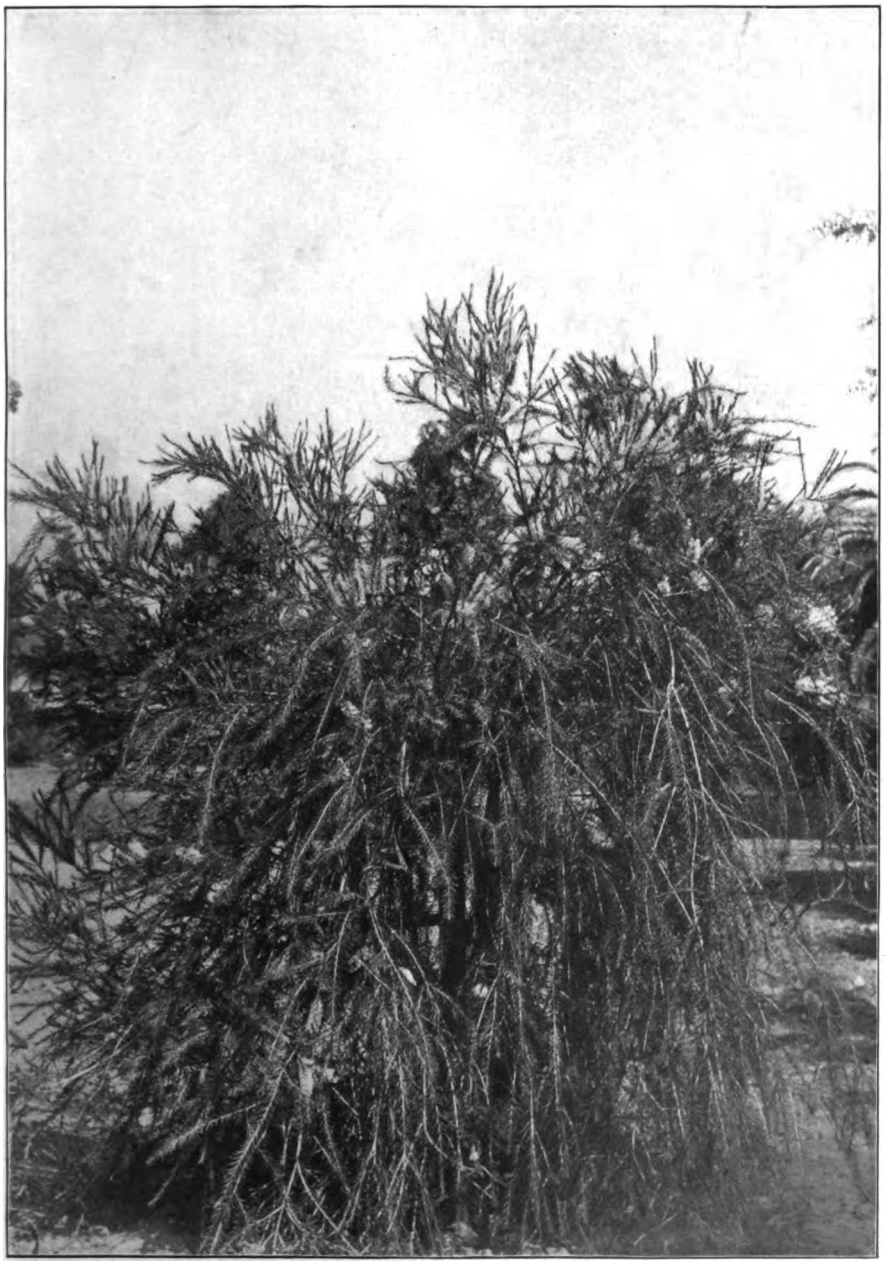

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PLATE 7.

Lyonothamnus floribundus var. **asplenifolius** Brandegee. ISLAND IRONWOOD.

Forty-five feet high, trunk diameter ten inches, age fifteen years. Grown in the Botanic Gardens, Berkeley, California, from seed brought from Santa Cruz Island by Dr. Franceschi.

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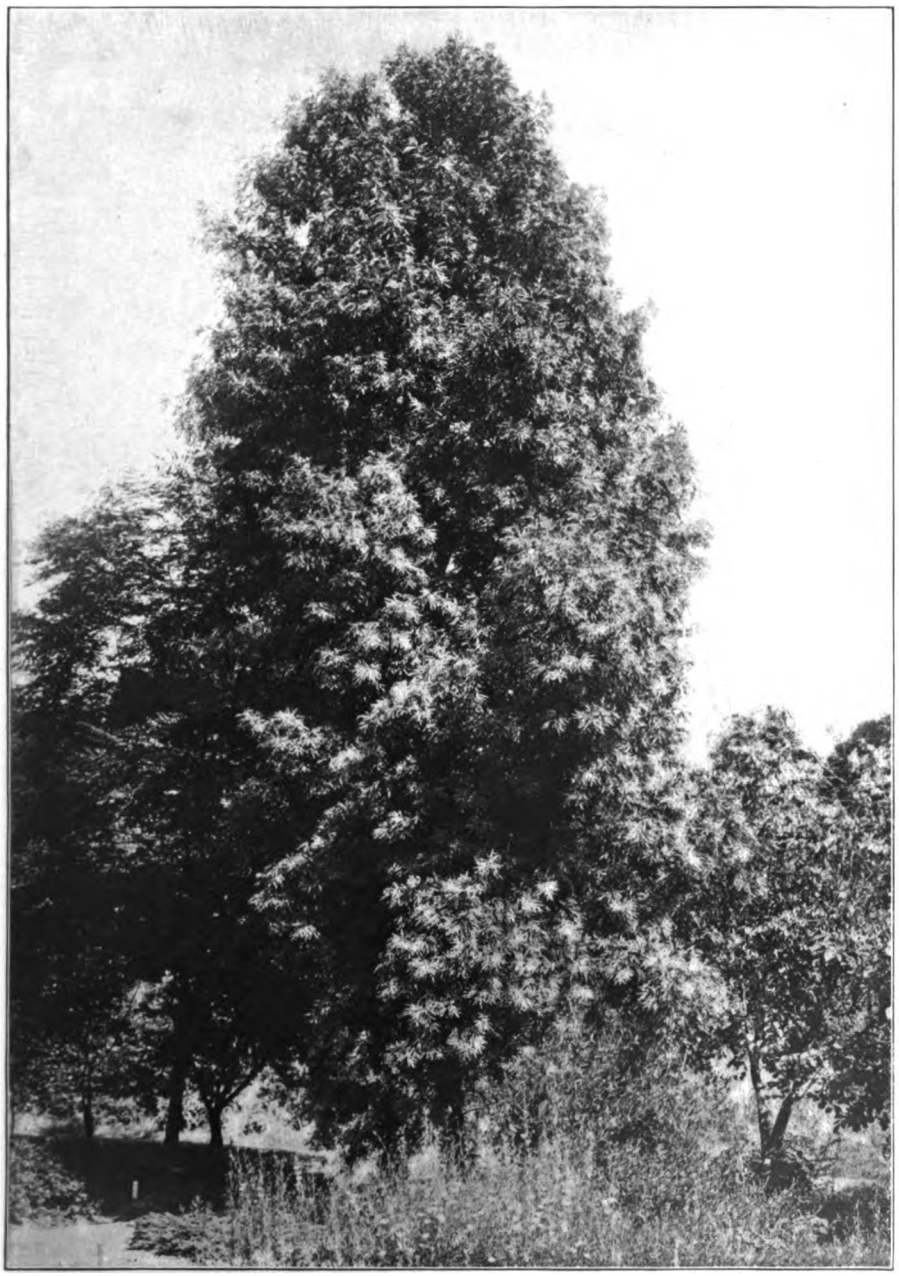

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PLATE 8.

Eugenia myrtifolia Sims. AUSTRALIAN BRUSH CHERRY.

Thirty feet high, trunk diameter eight inches, age fourteen years. Grown in Berkeley, California, in clay soil. Foliage evergreen, smooth and shining, with a pink tinge when young, becoming green as it matures. Flowers white, not conspicuous, followed by pinkish-green berries.

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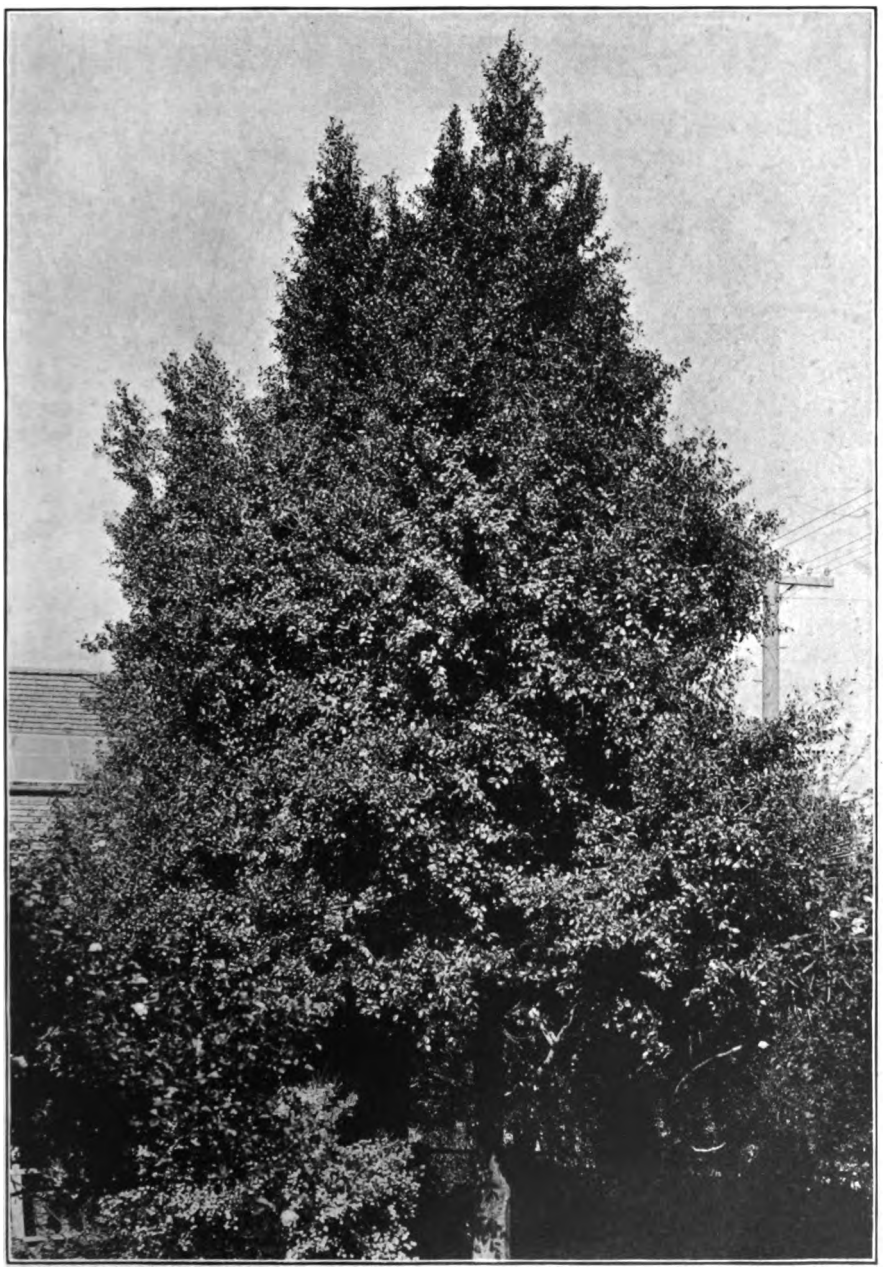

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PLATE 9.

Maytenus Boaria Mol. MAYTEN.

A young tree of somewhat irregular growth. The pendant branches characteristic. Flowers inconspicuous. Grown in the Botanic Gardens, Berkeley, California. Valuable as a lawn tree and for avenue planting where an evergreen is desired.

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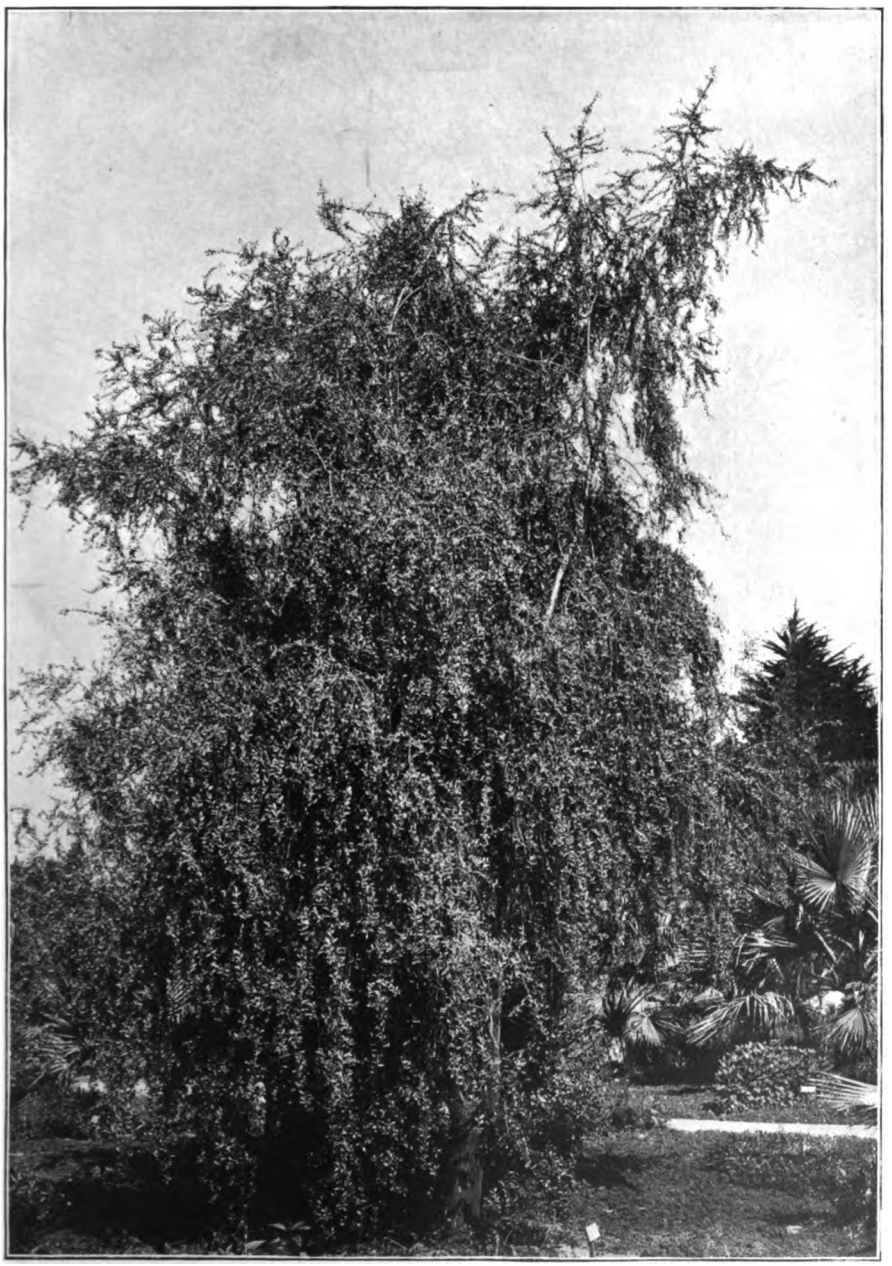

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PLATE 10.

Choisya ternata HBK. CHOISYA.

A typical plant, grown on the grounds of Hotel del Monte, California. Height five feet. Flowers white, occurring throughout most of the year, the photograph taken in April. Leaves ternately compound, green, smooth, and glossy.

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PLATE 11.

1. **Solanum Rantonnetii** Carr. BLUE-FLOWERED SOLANUM.

Branch taken from a vine twelve feet high, grown at Santa Barbara, California. Often trained as a flowering shrub and usually more floriferous than shown in this illustration. Flowers violet-blue.

2. **Feijoa Sellowiana** Berg. FEIJOA.

Flowering branch from a plant grown at Pasadena, California. Petals red, the inrolled margins white. Leaves green above, white-silky beneath. The plant is a tall shrub, grown as an ornamental and also for its perfumed fruits.

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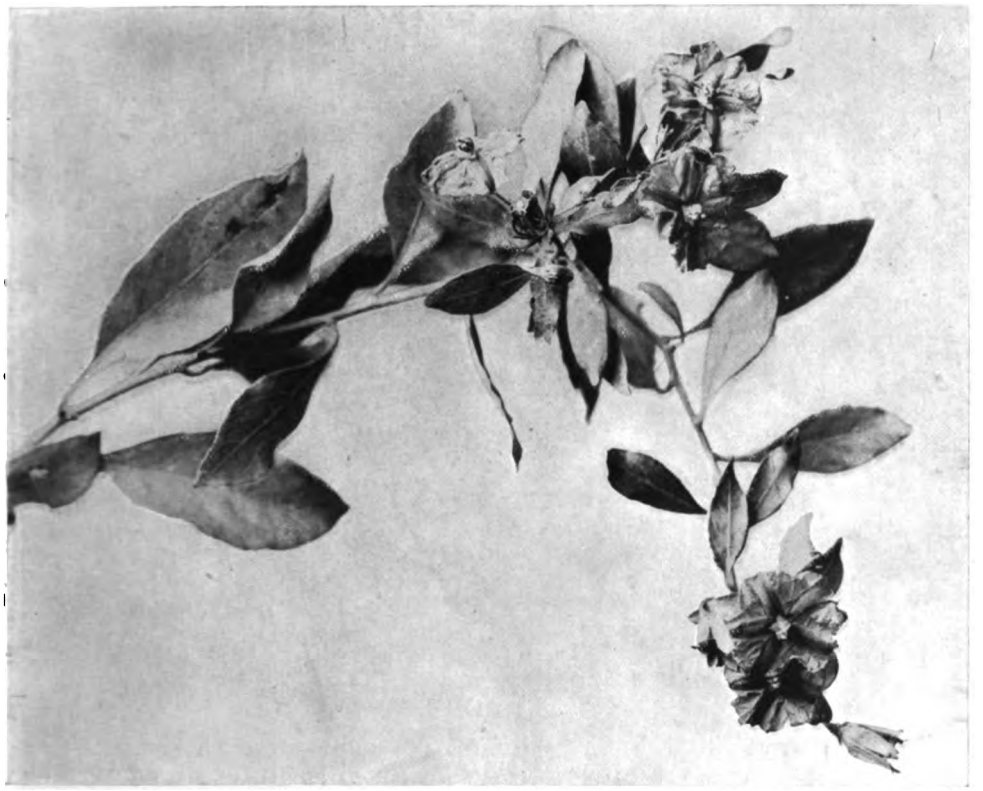

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GRACILARIOPHILA, A NEW PARASITE ON *GRACILARIA CONFERVOIDES*

BY
HARRIET L. WILSON

W. G. FARLOW

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VARIATIONS IN NUCLEAR EXTRUSION AMONG THE FUCACEAE.

BY
NATHANIEL LYON GARDNER.

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INTRODUCTION.

The group of brown sea-weeds known as the Fucaceae affords an excellent illustration of the manner in which our ideas have changed from time to time in regard to what should constitute the basis of classification of plants.

Linnaeus probably did more than any other person in modern times to stimulate investigation in systematic botany, being a most energetic and careful worker himself in this field of activity; but with Linnaeus the dominant idea concerning systems of grouping was purely artificial and conventional, his whole purpose being to devise systems whereby one could readily place in its proper group a newly discovered organism or easily trace an organism to its name after having once been classified. In other words, his system was wholly utilitarian in its purpose. To this end he would naturally seize upon the gross morphological characters and emphasize them. Groups were established

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Hooker (1845, p. 156) says that the specimens of Macrocystis occur along the west coast of South America from Cape Horn to the Equator and far westward in the Pacific amongst the Coral Islands. Macrocystis also occurs on the Australian coasts, off New Zealand, St. Paul Islands, the Crozet Islands, and is circumpolar generally in the southern hemisphere.

Professor W. A. Setchell called my attention to the manner of fructification in the few specimens in the Herbarium of the University of California which were in fruiting condition, and my principal study has been upon this problem.

The sori appear on the leaves as darker, thickened patches of irregular shape, varying from one-half to an inch and a half in width and from one-half to three or four inches in length, so far as the specimens examined were concerned.

The appearance of the sorus in cross-section shows the unicellular paraphyses and unilocular zoosporangia characteristic of the Laminariaceae closely pressed together, alternately arranged and covered at the top by a layer of firm colorless jelly.

Earlier writers evidently did not find anything which they recognized as fructification, for Turner (1809, p. 104) says "Fructification at present undiscovered."

C. A. Agardh (1821, p. 46) makes the following statement: "Fructus foliis intumescentibus immersus, constans e tuberculis ubique sparsis, extrinsecus poro minutissimo pertusis & intus includentibus glomerulos seminum numerosissimorum." This description of fruit was undoubtedly taken from a plant no longer included in the genus Macrocystis, viz., the Australian plant now known as *Phyllospora comosa*. Consequently this reference has no bearing on our present problem except to note that this first description of fructification applies to another genus.

The first reference to the fructification of Macrocystis as now understood was made by Mertens in 1829. Mertens (1829, p. 44) makes the following statement, "in einer kammförmigen Verdickung der Blattsubstanz unmittelbar oberhalb der Blase, welche Verdikkung sich durch ihre dunkle Farbe auszeichnet."

In 1831 (p. 172) Dr. Rudolphi also made mention of the fruit of Macrocystis in comparison with that of Ecklonia.

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Our first real knowledge of the fruit dates from 1839 when C. A. Agardh published his paper, "Revision der Algengattung Macrocystis" (1839, p. 294), in which he says: "Man bemerkt auf den Wurzelblättern oder understen Stammblättern grosser, dunkler gefärbte, unregelmässig begrenzte Flecken besondere auf der oberen Hälfte der Blattscheibe. Wenn der Inhalt dieser Flecken unter das Mikroskop gebracht wird, so wird man in Wassertropfen zwei verschiedene Körperchen gewahr, welche ich um sie besser zu bezeichnen gleich Sporidien und Perisporidien nennen will."

In Postels and Ruprecht (1840, p. 9) this statement appeared, "Fructificatio: Fila in centro stipitis obscura," but this idea is, of course, erroneous.

Various other references to the fruit of Macrocystis have been made by different authors, such as: "The fructification appears to be produced only on the newly formed submerged leaves." (Hooker: 1845, p. 156.) "Sporangienstände auf den grundständigen Blattkörpern." (Kjellman: 1893, p. 260.) "The fructification is found only on root leaves which never rise to the surface and are destitute of air vessels." (cf. Harvey: 1851, p. 84.)

For reference to fruit found on our own coast we turn to Saunders (1901, pl. LX), who gives a picture which shows the sori of Macrocystis.

Setchell and Gardner (1903, p. 270) say: "The sori are supposed to appear only on the bladderless radical leaves, but on specimens from Peru we have seen sori on leaves near the tip and provided with bladders."

While different authors have given the anatomy and histology of Macrocystis more or less detailed study, the Misses Smith and Whitting (1895, p. 84) published the first paper which has direct bearing on the present problem.

They give the following conclusions as the results of their investigations: (1) That the sori appear only on the newly formed bladderless leaves on the stem just above the holdfast, and (2) that the paraphyses and the zoosporangia appear only in the furrows of the leaf surface.

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My principal study was upon specimens gathered at Moss Beach, San Mateo County, California, by Professor Setchell on November 29, 1909, February 20, and April 3, 1910. The material of the last two gatherings was brought to me in fresh condition and was then preserved in a formalin solution. The specimens were found in shallow water, very nearly uncovered at the lowest tide, and while this plant seems to be somewhat different from those growing out in twenty to twenty-five meters of water there does not seem to be any good reason for considering it of a different species.

The Moss Beach plants were attached by a short holdfast, which consisted of a flattened rhizome-like structure bearing numerous hapteres, and from which arose several longer or shorter stems bearing leaves of various sizes and shapes. Some of these stems were as much as eight to ten meters long.

Examination showed that sori were present only on leaves near the base. These basal leaves differed from the upper leaves in one or both of two ways:

(1) Absence of bladders,—or

(2) Possession of a branching blade.

I have represented in plate 20, fig. 1, sori on leaves with and without bladders. In some of the leaves, division is unequal and unilateral and still in the very young stage like that of the terminal leaf from which the longer frond arises, and in the third leaf which bears a bladder at the base advanced, equal, dichotomous division has taken place. In no case did I find sori on leaves bearing single blades and with a bladder at the base.

In plate 20, fig. 2, I have represented the terminal leaves in the same condition as in fig. 1, and have also shown a bladderless equal dichotomous division of leaves bearing sori. The other leaves are identical with those in fig. 1.

I had the opportunity to examine several dried specimens of *Macrocystis pyrifera* which were gathered in Peru by D. G. Fairchild in 1899, which are preserved in the Herbarium at the University of California, and found that sori are present on the single blades of bladder-bearing leaves. It is not possible to decide how far from the holdfast the specimen preserved has

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been taken, but it is evident that the leaves which bear the sori are not newly formed basal ones and they must be at least three removes from the holdfast.

The other conclusion of the Misses Smith and Whitting's paper was that the reproductive bodies appeared only in the furrows of the leaves.

Cross-sections from the *Macrocystis pyrifera* gathered at Moss Beach showed that the paraphyses and the zoosporangia were arranged in unbroken layers which extend the entire breadth of the sorus and appear on both sides of the leaf. I also examined the sori of some dried specimens which were preserved in the herbarium (University of California) and found the fruit in regular layers in *Macrocystis pyrifera* from San Pedro, California, and in the same species from Peru the paraphyses and the zoosporangia were also arranged in continuous layers. No such conditions as a furrow in the leaf was found to exist. Some old wrinkled leaves suggested that possibility, but a section showed that no reproductive bodies were present.

Another specimen from Santa Cruz Beach, California, showed the same regularity of arrangement of the reproductive bodies.

The facts gained from this investigation have been quite different from those published by the Misses Smith and Whitting, for our specimens show that the sorus is not confined to the newly formed bladderless leaves alone and also that the reproductive bodies appear in continuous instead of disconnected layers only in the furrows of the leaves. The very different results obtained suggest that Misses Smith and Whitting may have worked with an entirely different species, but since they do not mention the localities from which their materials were gathered it is impossible to decide that question.

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ERYTHROPHYLLUM DELESSERIOIDES J. A.G.

BY

WILFRED CHARLES TWISS

W. G. FARLOW

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IN
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Vol. 4, No. 11, pp. 177-194 July 1, 1911

PLANTAE MEXICANAE PURPUSIANAE, III

BY
T. S. BRANDEGEE.

The collection of Mexican plants made by Dr. Purpus in 1910, in addition to the following new species, contains many that are rare and interesting. The range of many, especially those belonging to Arizona and Texas, is extended; for example, *Gilia aggregata, Salvia farinacea.* Many rare plants were found for the second time, among which may be mentioned *Tridax candidissima.* Some of the localities should be more definitely located. Sierra de la Paila is in the region of Parras. Cerro del Rey, Cerro de Zapatero, Cerro de San Ignacio, Cerro Barbecoa, Cerro de Cypriano, are all near the Hacienda Movano and along the boundary line between Coahuila and Durango.

Muilla Purpusii sp. nov.

Cormus diametro ca. 15 mm., brunneotunicatus. Scapus basi hispidus ca. 2 dm. altus. Folia graminiformia scapo breviora. Umbellula basi bracteosa, pedicellis ca. 3 cm. longis. Perianthii segmenta 9 mm. longa, oblongo-lanceolata, margine caerulea, dorso viridi-costata. Tubus brevissimus; filamentis caeruleis ad faucem tubi adnatis, antheris oblongis versatilibus, capsulis sessilibus, loculis 3–5-spermis.

The color of the flower is blue with green in the center of the perianth-segments. The perianth is rotate when fully expanded. Collected on Sierra de la Paila, Coahuila. No. 4959. Type, Herb. Univ. Calif., No. 148555.

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Drymaria axillaris sp. nov.

E radice ramoso multicaulis, 6–10 cm. alta, undique viscosa puberulaque: foliis quam internodiis brevioribus, late ovatis subito acuminatis, crassis, usque 10 mm. longis, 5 mm. latis; petiolis ca. 1 mm. longis; floribus solitariis bracteatis racemosis, bracteis quam internodiis longioribus foliis similibus sed minoribus; pedicellis ca. 4 mm. longis; petalis 4 mm. longis ad medium bifidis, sepala ovato-lanceolata margine alba vel rosea aequantibus; staminibus 5; stylo breviter trifido; capsula oblonga quam sepalis breviore; seminibus minute reticulatis demum fuscis.

Related to *D. polycarpoides,* also collected in the same region by Dr. Purpus, but easily separated from it by its viscous pubescence and leaf-like bracts. Although described as an annual *D. polycarpoides* is perennial. Both species grow from a deep branching root and specimens with only the upper slender part appear annual. Collected on Sierra del Rey, Coahuila. No. 4526. Type, Herb. Univ. Calif., No. 144769.

Thelypodium lobatum sp. nov.

Herbaceum e radice lignosa, caulibus ca. 3 dm. altis, basi hirsutis, superne stellato-hirsutis; foliis inferioribus 8 cm. longis, utrinque hirsutis, pinnati-partitis, segmentis oblongo acutis reflexis, 15 mm. longis, 5 mm. latis, petiolis ca. 2 cm. longis, foliis superioribus brevioribus; floribus albis, pedicellis 5 mm. longis; racemis 5 cm. (magisve) longis, ebracteatis; stylo brevi; stigmate capitato deinde bilobato; siliquis teretis, sessilibus hirsutis, 2 cm. longis.

Like pinnatiparted leaves generally, those of this plant are very variable in shape. Often the lobes extend to the rhachis and sometimes the rhachis is margined between the lobes. The lobes of the upper leaves become almost filiform. Collected on Sierra de Parras, Coahuila. No. 4561. Type Herb. Univ. Calif., No. 148556.

Thelypodium versicolor sp. nov.

Glabrum, 4–6 dm. altum; foliis caulinis sessilibus, basi auriculatis, margine integris, obtusis, 1–4 cm. longis, 0.5–1.5 cm. latis;

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foliis radicalibus spatulatis, margine serratis ciliatis ca. 4 cm. longis, 5–10 mm. latis; petalis 5 mm. longis, fere albis, quam sepalis violaceis duplo longioribus; siliquis 16 mm. longis erectis; pedicellis ca. 16 mm. longis.

The mature siliques are torulose and erect or sometimes slightly spreading. The different colors of the petals and sepals make a pleasing contrast. Collected on Sierra de Parras, Coahuila. No. 4978. Type, Herb. Univ. Calif., No. 146806.

Psoralea oligantha sp. nov.

Herbacea fere glabra, caulibus ca. 1 dm. longis: foliis 4–6 cm. longis, trifoliolatis, foliolo terminali late ovato acuminato, basi cuneato, ca. 2.5 cm. longo, 1.5 cm. lato; foliolis lateralibus minoribus fere sessilibus;; foliis inferioribus minoribus saepe foliolis orbiculatis; floribus capitatis, pedunculis quam foliis longioribus: calyce 7 mm. longo, infra medium fere aequaliter 5-lobato; corolla violacea; legumine immaturo obliquo-ovato.

This species is near *P. rhombifolia,* it has leaflets of the same shape but is nearly glabrous, the upper leaves have long petioles and the legume does not have the long beak of *P. rhombifolia.* The pod of *P. rhombifolia* is circumscissile above its base falling with the enclosed seed. Collected at high elevations on Sierra de Parras, Coahuila. No. 4583. Type, Herb. Univ. Calif., No 144765.

Dalea sabulicola sp. nov.

Verisimiliter annua, caule 3–5 cm. alto, hirsuto; foliis paucis ca. 2.5 cm. longis, dense hirsutis; foliolis usque 4-jugis, obovatis acutis basi cuneatis; capite cylindraceo, 3–5 cm. longo; bracteis lineari-lanceolatis, margine apiceque hirsutis, calycis tubum superantibus; calycis dentibus setaceis tubo duplo longioribus, longe hirsutis; floribus violaceis.

Collected on Sierra de la Paila, Coahuila, growing in gravelly soil. No. 4740. Type, Herb. Univ. Calif., No. 148289.

Dalea parrasana sp. nov.

Caulibus e radice lignosa 5–12 cm. altis, strigoso-hirsutis; foliis ca. 2 cm. longis, hirsutis; foliolis 3–4-jugis, oblongo-ovatis,

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apice acutis, basi cuneatis; stipulis filiformibus; capitibus 3–4 cm. longis; bracteis late ovato-acuminatis, longe ciliatis; calycis dentibus 7 mm. longis, setaceis, longe sericeo-villosis; floribus flavis.

This species has short stems and a stout woody root. The heads are large for the size of the plant and the long broadly lanceolate bracts are very conspicuous. No. 4741, collected on Sierra de Parras, Coahuila. Type, Herb. Univ. Calif., No 148240. Dr. Purpus collected it near Parras in 1905, but not in quantity for distribution.

Dalea quinqueflora sp. nov.

Frutex ramosus glaber, cortice fusco; foliis ca. 8 mm. longis, 4-jugis; foliolis 3 mm. longis, 0.5 mm. latis, oblongis obtusis, utrinque glanduliferis; capitibus saepe 5-floris, floribus flavis, bracteis glabris latis, amplectis; pedunculo 7 mm. longo; bracteis acutis, obscure glanduliferis; calyce sericeo-pubescente, 5 mm.

This species is well marked by its few-flowered heads and especially by the broad persistent bract which enwraps each flower. Collected at Buena Vista, San Luis Potosi. No. 4837. Type, Herb. Univ. Calif., No. 148416.

Eysenhardtia parvifolia sp. nov.

Fruticulus cortice fusco; foliis 12 mm. longis puberulis; foliolis 4–6-jugis, ovatis, ca. 2 mm. longis, punctis glandulosis conspersis; racemis 5–10 mm. longis, lignosis, paucifloris; bracteis diu persistentibus, subulatis 2 mm. longis; vexillo parum emarginato; staminibus connatis; stylo eglanduloso apice uncinato; ovario 2-ovulato, ovulis superimpositis; legumine glanduloso-punctato, stricto, ca. 8 mm. longo, 2 mm. lato, 2-spermo.

The specimens are from an intricately branched bush. The species is nearest *E. spinosa*, but has a very different pod. Collected on Sierra de Parras, Coahuila. No. 5074. Type, Herb. Univ. Calif., No. 150014.

Eysenhardtia peninsularis sp. nov.

Frutex cortice fusco glabro; foliis 10–15 mm. longis, puberulis; foliolis obovatis vel oblongis, ca. 5 mm. longis, 5-jugis;

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racemis 2–5 cm. longis, rhachi albopubescente; bracteis diu persistentibus, spinosis; calycibus pubescentibus; vexillo parum emarginato; stylo apice uncinato, glanduloso. Legumen ignotum.

This species is an intricately branched shrub easily distinguished from *E. amorphoides* by its spinose bracts. Collected in Baja California by T. S. Brandegee and listed in Proc. Cal. Acad., 2nd Ser. II, 148, as *E. spinosa.* Type, Herb. Univ. Calif., No. 83928.

Rhynchosia potosina sp. nov.

Caules erecti vel volubiles, ramosi, striati, 3–4 dm. alti, pubescentes: foliis trifoliatis, ca. 8 cm. longis, foliolis lateralibus inaequilateralibus, late ovatis acutis subtus hirsutis reticulatis; foliolo terminali, quam lateralibus majore, ca. 3 cm. longo, 2.5 cm. lato; racemis axillaribus, paucifloris: calyce campanulato, flavo-hirsuto, 5-dentato; floribus flavis; vexillo dorso pubescente; legumine hirsuto, ca. 2.5 cm. longo; seminibus orbiculis alba notatis.

Collected on a high sierra near Guascama and Agua Media, San Luis Potosi. No. 4845. Type, Herb. Univ. Calif., No. 148386.

Fagonia scoparia sp. nov.

E radice lignosa multicaulis, erecta ramosa aphylla ca. 15 cm. alta: pedicellis 5–10 mm. longis; sepalis ovato-acuminatis quam petalis duplo longioribus, acuminatis roseis; ovario dense albosericeo hirsuto; stipulis minutis tenuis.

This plant grows in broom-like clumps with fragile branches easily breaking at the joints. The old leaves of *F. californica* are deciduous, but with all the numerous specimens of the University of California Herbarium even when old enough to have lost all flowers and fruit some leaves persist. The specimens of *F. scoparia,* although they have flower buds and young shoots, show no sign of a leaf. Collected on Cerro del Macho, Coahuila. No. 4495. Type, Herb. Univ. Calif., No. 143345.

Linum macradenium sp. nov.

Multicaule e radice lignosa, caulibus ca. 3 cm. altis, hirsutis, ramosis; foliis oblongo-lanceolatis acutis vel obtusis, apice

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saepissime cum glandula magna instructis, subtŭs pubescentibus, supra glabris; glandulis stipularibus; petalis flavis cuneato-oblongis, 1 cm. longis; calycis lobis ovato-acuminatis, nervo medio prominente, margine dense glanduloso-cilatis: stylis liberis: pedicellis ca. 3 mm. longis: capsula acuta calycem superante.

This species is nearest *L. scabrellum*, but is more glandular and hirsute. The large glands are abundant on the upper leaves and bracts. Collected at Minas de San Rafael, San Luis Potosi, No. 4923. Type, Herb. Univ. Calif., No. 148804.

Echinopterys setosa sp. nov.

Fruticosa, ramosa, caulibus hirsutis cinereis; foliis oblongo-obovatis basi angustatis, fere sessililibus, utrinque glabris, ca. 1 cm. longis, 2 mm. latis: pedicellis ca. 1 cm. longis: stylis apice coalitis: fructuus setis saepissime rectis glabris.

This differs from *E. eglandulosa* in having the styles united only at the apex and the bristles of the fruit stouter and not plumose, otherwise it is very much like it. Collected on Sierra de la Paila, Coahuila. No. 4950. Type, Herb. Univ. Calif., No. 148802.

Helietta lucida sp. nov.

Frutex cortice fusco, ramis juvenibus puberulis; foliis trifoliatis, petiolis 2–4 cm. longis puberulis, foliolo terminali 7–11 cm. longo, ca. 2.5 cm. lato, ovato-lanceolato, basi cuneato, glabro, lucido reticulato, margine integro, foliolis lateralibus similibus minoribus; fructu alas includente 3 cm. longo, pubescente, alis 4–5 reticulatis, apice rotundatis; stylo persistente capitato. Flores desunt.

The few specimens collected were fruiting. The leaves are shining papyraceous and conspicuously reticulated. Collected in the vicinity of San Luis Tultitlanapa, Puebla. No. 4451. Type, Herb. Univ. Calif., No. 143302.

Polygala magdalenae sp. nov.

Caules basi lignosi, pauciramosi pubescentes striati 1–3 dm. alti: foliis nunc oblongo-ovatis nunc lineari-lanceolatis puberulis petiolatis, 1–2 cm. longis, 2–8 mm. latis: racemis terminalibus

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laxifloris; floribus mediocribus ochroleucis; sepalis lanceolatis pubescentibus; alis late ovatis subunguiculatis margine ciliatis; petalis superioribus cum tubo staminali per dimidium connatis, late linearibus, apice dilatatis obtusis, quam carina ⅓ brevioribus; ovario ovato piloso; stylo curvato, stigmate superiore ab alio paullo separato; staminibus 7; capsula oblonga, late marginata apice emarginata pubescente, 7 mm. longa, 6 mm. lata; semine pyriformi 4 mm. longo, compresso piloso, arillo corneolo capitelliformi margine papyraceo undulato.

This species has been noted in lists of Lower California Plants as *P. xanti* and *P. puberula,* from both of which it is very distinct. It is near *P. leptosperma,* but differs in the shape of the capsule, the relative position of the stigmas and shape of the superior petals. *P. Xanti* is a prostrate plant, with wings exceeding the keel and the base of the flower is conspicuously gibbous. *P. magdalenae* has been collected by the writer at Magdalena and Santa Margarita islands, Todos Santos of the Cape Region and San Jose del Cabo, all in Baja California. Herb. Univ. Calif., Nos. 109758, 109749, 137739, 109756, 133558.

Polygala nudata sp. nov.

Multicaulis e radice lignosa, caulibus ca. 15 cm. altis, basi frutescentibus, fere glabris: foliis paucis bracteiformibus sessilibus acutis: racemis terminalibus ca. 6 cm. longis paucifloris rectis: floribus ca. 4 mm. longis albis: sepalis ovatis acuminatis viridibus, alis ovato-oblongis: petalis superioribus oblongis apice dentatis: carina cristata, crista cornuta integra oblonga: capsulis oblongis glabris: seminibus ovali-oblongis, pilis sericeis vestitis; carunculis corneis bidentatis, dentibus perpendicularibus brevibus.

Compared with the figures of *P. arizonae* in Chodat's Monograph of Polygalaceæ; the wings are nearly alike, the superior petals dentate instead of entire, the capsule with the persistent sepal is the same but less notched at the top, the caruncle is very different and the rhachis is not zigzag. The hornlike crest is short and the plant has the appearance of being leafless. Collected on Sierra de la Paila, Coahuila. No. 4762. Type, Herb. Univ. Calif., No. 148239.

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Euphorbia collina sp. nov.

Caules ramosi basi lignosi dense glanduloso-pubescentes, ca. 18 cm. alti: foliis oppositis breviter petiolatis rotundo-ovatis, ca. 5 mm. longis, 3–4 mm. latis, margine glanduloso-ciliatis: involucris ca. 1 mm. longis solitariis in axillis foliorum ramorum brevium, quam pedicellis longioribus, pubescentibus turbinatis; glandulis 4 stipitatis oblongis fuscis parvis concavis, appendice alba vel rosea oblongo-rotundata ca. .5 mm. longa lataque; capsulis pubescentibus, coccis carinatis, pedicellis a latere fisso involucri deflexis; stylis ad medium bipartitis; semine cinereo oblongo tetragonō crasse rugoso, angulis acutis crenatis.

All the specimens collected are mature and many of the leaves are rose-colored. Dr. William Trelease obligingly compared this species with *E. arizonica* and assures me that it is very distinct from it. Collected on Cerro de San Ignacio, Durango. No. 4599. Type, Herb. Univ. Calif., No. 144767.

Euphorbia scopulorum sp. nov.

Fruticosa ramosissima, ramis albo-pubescentibus: foliis oppositis fere sessilibus, e basi inaequali, ovato-acuminatis crassis, margine revolutis, nervo medio subtus prominulo, ca. 6 mm. longis, 3–4 mm. latis, dense pubescentibus; stipulis brevibus lineari-lanceolatis: involucris solitariis axillaribus campanulatis, 1.5 mm. longis; pedicellis 0.5 mm. longis; glandulis 4, orbiculatis, appendice alba 4-dactyliforme: capsula pubescente trigona; semine tetragono cinereo laevi, 1.5 mm. longo; stylo brevi ad medium bifido.

The bases of the stems are woody and come from a stout ligneous root. Collected on Cerro de Cipriano, growing in crevices of rocks. No. 4513. Type, Herb. Univ. Calif., No. 143272.

Sida potosina sp. nova.

Suffruticosa, caulibus 3–4 dm. altis, basi ramosis, stellato-pubescentibus; foliis ellipticis crenato-dentatis, utrinque pubescentibus; petiolis 2–10 mm. longis: floribus solitariis axillaribus; pedunculis 5–9 cm. longis; corolla flava 15 mm. lata; calycis

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segmentis deltoideis pubescentibus; bracteolis nullis; carpellis ca. 10, muticis.

This is a species having many branching stems woody at base. The flowers are on very long peduncles arising from the axils of the upper leaves and much surpassing them. Collected at Minas de San Rafael, San Luis Potosi. No. 4906. Type, Herb. Univ. Calif., No. 148803.

Vincetoxicum (Chthamalia) camporum sp. nov.

Caules pubescentes erecti, 2–3 dm. longi: foliis profunde cordatis longe acuminatis usque 4 cm. longis, 2.5 cm. latis: pedunculis 5–10 mm. longis 2–5-floris. calycis lobis oblongo-ovatis acutis parce pubescentibus: corolla campanulata virido-purpurea reticulata, 7 mm. longa, intus glabra extus pubescente: stigmate vertice depresso, corona crateriformi basi columnae affixa, margine cum ligulis basi callosis stigma superantibus instructa: folliculis ignotis.

This species differs from *Gonolobus bifidus,* which it much resembles in having the ligules of the corona entire and the ovate lobes of the corolla glabrous within. Collected on plains near Movano, Coahuila. No. 4484. Type, Herb. Univ. Calif., No. 143287.

Breweria multicaulis sp. nov.

Undique sericeo-albo-tomentosa, multicaulis e radice lignosa, 2–4 dm. alta: foliis sessilibus lanceolatis acuminatis, basi cuneatis, 15–20 mm. longis, 4–5 mm. latis: pedicellis 5 mm. longis in axillis foliorum superiorum solitariis, bracteas aequantibus: sepalis ovato-acuminatis 1 cm. longis: corolla 3.5 cm. longa, diametro 3 cm., caerulea: stylo ad medium bipartito; ovario sericeo-hirsuto; semine abortu unico.

This plant is nearest to *B. ovalifolia,* a prostrate species with cordate leaves. Collected near Sierra del Rey, Coahuila. No. 4457. Type, Herb. Univ. Calif., No. 143306.

Phacelia (Euphacelia) arenicola sp. nov.

Viscido-pubescens, caulibus ramosis suffrutescentibus 4–5 dm. altis: foliis late ellipticis margine profunde crenatis, superioribus sessilibus: spicis 5–12 cm. longi paullo cymosis: floribus

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fere sessilibus: calycis lobis obovatis acuminatis 2.5 mm. longis parce hirsutis; corolla albo-purpurea 5 mm. longa, staminibus longe exsertis; stylo ultra medium partito; capsula globosa calycis lobos aequante; seminum testo areolato.

This species in its general appearance resembles *P. caerulea*. Collected growing in sand at El Toro, near Movano, Coahuila. No. 4458. Type, Herb. Univ. Calif., No. 143334.

Nama Purpusii sp. nov.

Suffrutescens albo-hirsutum foliosissimum; foliis angusto-linearibus obtusis, 2.5 cm. longis, sessilibus, marginibus revolutis; floribus ramos breves axillares terminantibus; sepalis obtusis sursum parum ampliatis; corolla 1 cm. longa quam sepalis longiore, hypocraterimorpha cum tubo lato: staminibus inaequaliter affixis; filamentis inaequilongis usque ad medium corollae adnatis, marginibus liberis edentatis; stylis capitatis; capsula oblonga acuminata.

Only a few specimens were collected. They are branches of an upright plant, densely hirsute with long white hairs and crowded with leaves so revolute as to appear cylindrical. The flowers from the dried specimens seem to have been of a violet-purple color. No mature fruit was obtained. Collected near Movano, Coahuila. No. 4563. Type, Herb. Univ. Calif., No. 144716.

Coldenia Purpusii sp. nov.

Suffruticosa prostrata hispida, caulibus tenuibus, saepe ad nodos radicantibus: foliis anguste ovatis acuminatis, margine cum setis ciliatis: floribus violaceis ad apices ramorum congestis: calycis segmentis lineari-lanceolatis cum setis ciliatis: stylis superne bifidis: verisimiliter nuculis secedentibus.

The specimens consist of numerous fragments of a prostrate spreading plant that sometimes roots at the nodes. They have few violet-blue flowers and although very mature hardly any fruit. The species seems nearest *C. canescens*. Collected at Minas de San Rafael, San Luis Potosi. No. 4857. Type, Herb. Univ. Calif., No. 148453.

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Scutellaria potosina sp. nov.

Puberula e radice lignosa multicaulis; caulibus simplicius-culis, ca. 1.5 dm. altis, foliosis; foliis ovatis obtusis, margine integris, 6 mm. longis, 4 mm. latis, breviter petiolatis, utrinque viridibus: floribus axillaribus fere sessilibus, violaceis, 8 mm. longis: seminibus grosse tuberculato-rugosis, atris.

The specimens are so mature that all the fruit has fallen and few flowers remain. Collected at Minas de San Rafael, San Luis Potosi. No. 4874. Type, Herb. Univ. Calif., No. 148366.

Salvia Purpusii sp. nov.

Fruticulus, ramis cinereis cum pilis brevibus hispidis partim glandulosis instructis, cortice denique deciduo ramos laeves relinquente: foliis late ovatis vel oblongo-ovatis obtusis, basi cordatis, margine crenatis, cum pilis brevibus glandulosis pubescentibus; nunc demum rugosis, 2–3 cm. longis, 1–2 cm. latis; petiolis ca. 5 mm. longis: racemis 3–6 cm. longis; verticillis 2-floris; bracteis deciduis late ovatis obtusis vel acutis pubescentibus; pedicellis 4 mm. longis; calyce late campanulato glanduloso, 1 cm. longo, labiis aequalibus, superiore 3-dentato, inferiore cum lobis acutis: corolla 18 mm. longa, violacea, tubo gradatim ampliato, galea pubescente labio inferiore breviore; stylo glabro.

Collected on Cerro de Zapatero, Coahuila. No. 4636. Type, Herb. Univ. Calif., No. 144749.

Salvia farinacea Benth. var. **heteranthera** var. nov.

Calyx corollaque minores pubescentiores; connectivis postice bipartitis.

This Texan species has not heretofore been credited to Mexico. The variety differs in having the calyx more tomentose and especially in having the posterior portion of the connective deeply lobed. But few specimens were collected, probably only for the fungus with which they are infested. Sierra de la Paila, Coahuila. No. 4754. Type, Herb. Univ. Calif., No. 148256.

Salvia parrasana sp. nov.

Perennis, caulibus ascendentibus ca. 2 dm. altis parce pilosis cum pilis glanduliferis: foliis inferioribus late ovatis obtusis,

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basi in petiolum alatum cuneatis, crenatis, subtus paucis pilis curvatis, rubropunctatis, supra sparsim pilosis, foliis superioribus similibus majoribus ca. 3–4 cm. longis, petiolum alatum includentibus, 1.5–2 cm. latis; pedunculis 4–6 cm. longis: verticillis approximatis ca. 6-floris, pedicellis 1 cm. longis, bracteis ovatis acuminatis cum pilis longis ciliatis; calyce campanulato, 5 mm. longo, setuloso rubropunctato, labio superiore integro cum nervo excurrente mucronato, lobis labii inferioris acuminatis; corolla 1 cm. longa, violacea, tubo calyci aequali, labio inferiore quam galea duplo longiore, connectivis postice longitudinaliter connatis, supra dilatatis calloso-dentatisque, stylo supra densissime barbato.

Collected at high altitudes of Sierra de Parras, Coahuila. No. 4637. Type, Herb. Univ. Calif., No. 144748.

Hedeoma montana sp. nov.

Frutescens ramosa, 1.5–2 dm. alta; foliis pubescentibus ovatis acuminatis dentatis, ca. 8 mm. longis, basi in petiolum angustatis; verticillastris ad apices ramorum axillaribus; corollis violaceis, 12 mm. longis calyce pubescente duplo longioribus, fauce inflata; calycibus tubulosis striatis parum gibbosis, dentibus erectis lineari-lanceolatis consimilibus, ca. 2 mm. longis, sub fauce intus villosis; staminibus 2 exsertis, filamentis sterilibus nullis; antherarum loculis demum divaricatis.

Collected on Sierra de la Paila, Coahuila. No. 4964. Type. Herb. Univ. Calif., No. 150013.

Lithophytum gen. nov. **Solanacearum?**

Calyx campanulatus 5-lobatus. Corolla gamopetala 5-lobata. Stamina 5, tubo corollae affixa, lobis alternantia. Ovarium superum 1-loculare, ovula 2–4 saepissime 2, juxta basin parietalia. Stigma sessile. Fructus ignotus. Frutex ramosus, cortice fusco-cinereo. Folia ad nodos fasciculata crassa.

Lithophytum violaceum sp. nov.

Ramis longis diametro ca. 5 mm. glabris, internodiis 6–10 mm. longis; foliis ellipticis, 2.5 mm. longis, 4 mm. latis, margine integris minute ciliatis, basi cordatis, mucronatis, primum obtusis demum emarginatis, nervis contralibus et intramarginalibus

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ad apices conjunctis: floribus ad nodos vel foliosos vel aphyllos pedicellatis, pedicellis 2 mm. longis: calyce 3–4 mm. longo, fere ad basim 5-lobato, lobis lanceolatis puberulis: corolla violacea 8 mm. longa, extus puberula, tubo cylindraceo supra ampliato, lobis venosis patentibus inaequalibus, 2 superioribus brevioribus: staminibus saepe tubo inaequaliter adnatis, antheris dorso prope basim sagittatam affixis, loculis per totam longitudinem dehiscentibus: stigmate parvo bilobato; disco ovario aequilongo.

This anomalous plant has corollas that suggest *Verbenaceae*, but the five perfect stamens belong rather to *Solanaceae*. The 1-celled ovary is uncommon in both orders. It seems to be related somewhat to *Henoonia*. The lobes of the corolla are conspicuously pinnate-veined. The ovules, generally two, sometimes three and rarely four, are attached to the walls of the ovary near the base or slightly above it. Collected at Santa Lucia, Puebla, April, 1908, growing among rocks. No. 4450. Type, Herb. Univ. Calif., No. 143297.

Stemodia Purpusii sp. nov.

Perennis multicaulis e radice lignosa 1–1.5 dm. alta, resinosa puberula: foliis oppositis sessilibus oblongis acuminatis acute serratis, inferioribus 5 mm. longis, 4 mm. latis, superioribus minoribus; floribus solitariis axillaribus, pedicellis foliis brevioribus; calyce 6–7 mm. longo quam bracteolis linearibus longiore, lobis lanceolatis inaequalibus; corollis caeruleis 10–12 mm. longis, tubo intus piloso gradatim ampliato; capsula calycem aequante demum valvis 4 dehiscente; antherarum loculis stipitatis.

Collected at Movano, Coahuila. No. 4456. Type, Herb. Univ. Calif., No. 143232.

Pentstemon punctatus sp. nov.

Frutescens, caulibus juvenibus purpureis puberulis; foliis glabris oblongis spathulatisve, basi cuneatis, sessilibus, punctatis ca. 3 cm. longis, 1 cm. latis; panicula pauciflora; pedunculis pubescentibus; bracteis ovato-acuminatis puberulis; pedicellis 5–15 mm. longis; capsula ovato-acuminata quam sepalis duplo longiore; floribus violaceis 1.2 cm. longis; antherarum loculis demum explanatis, margine ciliatis.

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The specimens are very mature and bear but few flowers. Collected on Sierra de la Paila, Coahuila. No. 4747. Type, Herb. Univ. Calif., No. 148291.

Pinguicula gypsicola sp. nov.

Foliis exterioribus rosulatis oblongis obtusis fuscis puberulis carnosis, 4–7 mm. longis: interioribus lineari-lanceolatis, ciliatis cum pilis multiarticulatis, 4–6 cm. longis, basi 2–7 mm. latis: corollae caerulae tubo, quam lobis multo breviore; lobis oblongo-spatulatis patentibus, ca. 6 mm. longis: calcare tenui, ca. 2 cm. longo: scapo 4–7 cm. longo.

A handsome species collected on wet gypsum rocks at Minas de San Rafael, San Luis Potosi. No. 4886. Type, Herb. Univ. Calif., No. 148373.

Carlowrightia parvifolia sp. nov.

E radice lignosa multicaulis 1–2 dm. alta; caulibus ramosis retrorsum pubescentibus; foliis inferioribus oblongo-lanceolatis basi angustatis ca. 8 mm. longis, 2 mm. latis, foliis superioribus linearibus; pedicellis ex axillis foliorum superiorum, 5–10 mm. longis, prope apicem bracteatis; calyce 4–5-partito, segmentis retrorsum pubescentibus; corollae tubo 2 mm. longo, lobis 5 mm. longis, 2.5 mm. latis; antherarum loculis contiguis parallelis, loculo altero altius affixo; capsula 1 cm. longa, basi in stipitem solidum 5 mm. longum contracta; seminibus cordatis, uno latere rugosis altero scabridis.

Collected on Sierra de la Paila, Coahuila. No. 4751. Type, Herb. Univ. Calif., No. 148260.

Lobelia Purpusii sp. nov.

Verisimiliter annua, glabra pusilla rupes humidas habitans: caulibus 8–13 cm. altis, tenuibus; foliis lineari-lanceolatis sessilibus, basi angustatis, ca. 2.3 cm. longis, 1 mm. latis, margine hirsutulis: racemis paucifloris aphyllis; pedicellis ca. 16 mm. longis; bracteis ca. 5 mm. longis linearibus; calycis tubo breviter obconico, laciniis linearibus quam tubo multo longioribus: corolla 1 cm. longa caerulea; antheris inferioribus barbatis: capsula fere globosa semilibera.

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Growing in masses on wet rocks at Zacuapan, Vera Cruz. No. 4933. Type, Herb. Univ. Calif., No. 148806.

Ericameria Purpusii sp. nov.

Fruticulus ramosus, foliolis lineari-lanceolatis acuminatis ca. 2 mm. longis in axillis foliorum 5–7 mm. longorum linearium acuminatorum decurrentium demum cinereorum spinescentium fasciculatis: capitulis ramos terminantibus 6–7 mm. altis fere sessilibus discoideis; involucri bracteis 4–5 seriatis ovato-lanceolatis acuminatis gradatim in folios mutantibus; corollis 8–10, luteolis in lobos ovato-lanceolatos inaequaliter sectis; stigmatibus apice appendicibus lanceolatis terminantibus; antheris liberis; pappi setis copiosis corollam aequantibus; achaeniis turbinatis 2.5 mm. longis dense sericeo-villosis.

This species is remarkable for its spinose leaves and peculiar corollas. One lobe of each flower separated to the tube is much longer than the others. Technically its rayless heads would place it in *Bigelovia* as elaborated by Dr. Gray, but its habit and appearance is that of an *Ericameria*. It would be abnormal in any described genus. Collected on Cerro de Macho, Coahuila. No. 4479. Type, Herb. Univ. Calif., No. 143238.

Verbesina parrasana sp. nov.

Caulibus, basi lignosis, ramosis, scabris, 2–3 dm. altis; foliis inferioribus oppositis, superioribus alternis ovato-acuminatis usque 4 cm. longis, 3 cm. latis, grosse-serratis, trinervatis, basi in petiolum ca. 1.2 cm. longum anguste alatum cuneatis; capitulis ramos terminantibus; pedunculis 3–5 cm. longis; involucri squamis 2-seriatis, oblongo-lanceolatis, 1.2 cm. longis, 2 mm. latis, pubescentibus; floribus radii flavis fertilibus, disci floribus numerosis, tubo brevi, fauce gradatim ampliata; antheris fere atris; radii achaeniis obtuse triangulis glabris rugosis, apice rotundis, calvis, disci achaeniis compressis cuneatis late alatis hirsutis; pappi aristis 2, achaenium aequantibus.

The heads are 3.5 cm. in diameter. The ray akenes are triangular in cross-section and (rarely) bear an awn similar to those of the disk akenes. The disk akenes are flattened and have a rib on one or both faces. Sometimes they are 3-winged and

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3-awned with two of the awns contiguous. Collected on Sierra de Parras, No. 4635, and on Sierra de la Paila, No. 4640, Coahuila. Type, Herb. Univ. Calif., No. 144747.

Perymenium cornutum sp. nov.

Caules ultra 3 dm. alti stricti striati scabro-pubescentes herbacei purpurei foliosi; foliis ovato-lanceolatis margine serratis, ca. 5 cm. longis, 2 cm. latis, supra parce scabro-hirsutis, subtus pallidioribus scabro-pubescentibus; petiolis ca. 1 cm. longis hirsutis cum pilis patentibus: capitulis caules terminantibus, pedunculis 5–9 cm. longis; involucri squamis ovatis circiter biseriatis, exterioribus obtusis, interioribus acutis; floribus ca. 25, radii 1 cm. longis, flavis; paleis conduplicatis acuminatis; achaeniis disci obovatis crassiusculis atrobrunneis plus minusve bullato-rugosis compressis 3 mm. longis 2 mm. latis truncatis, angulis duobus in cornua brevia terminantibus; pappi aristis flavidulis inaequalibus usque 4 mm. longis.

The specimens do not have the root and are very mature. The color of the akenes is variable and often the horns are absent. The leaves near the tip are curved downwards and in the pressed specimens are often conduplicate. Collected at Agua Media, San Luis Potosi. No. 4767. Type, Herb. Univ. Calif., No. 148401.

Pectis panamensis sp. nov.

Annua ramosissima glabra 1–2 dm. alta: foliis oblongo-linearibus acutis margine integris, basi setis paucis instructis, glanduloso-punctatis, 1–4 cm. longis, 2 mm. latis: capitulis solitariis axillaribus, pedunculis 1–3 cm. longis; involucri squamis 8 acuminatis, 3–4 mm. longis, glandulis paucis linearibus, dorso costa elevata notatis; flosculis liguliferis ca. 8 luteolis, disci 8–10; pappi squamis paucis ovatis acuminatis laceratis .05 mm. longis, apice interdum aristatis; achaeniis ca. 2 mm. longis parce pubescentibus.

This species differs from the description of *P. swartziana* in having in place of obtuse pappus scales those that are acute, lacerate and sometimes aristate and the leaves have four rows of small glands instead of two. The lacerate pappus is much

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like that of some species of *Hymenatherum*. Communicated by Señor Bolivar Jurado and collected in Panama, fifty miles south of the Canal Zone. Type, Herb. Univ. Calif., No. 143320.

Cacalia calva sp. nov.

Caules herbacei e radicibus bulbosis 4–5 dm. alti pubescentes: petiolis foliorum radicalium ca. 2 dm. longis, tomentosis basi dense lanatis, laminis circumscriptione orbiculatis diametro 10–14 cm. palmato-multipartitis, segmentis trisectis, foliis paucis caulium multo brevioribus alternis; capitulis discoideis paniculato-cymosis, pedunculis 2–6 cm. longis 3–4-bracteolatis; involucri squamis ca. 12 lineari-lanceolatis 1-seriatis 8 mm. longis, ca. 1 mm. latis, apice lanatis; corollae tubo tenui cylindraceo 3–4 mm. longo, lobis 5 profunde partitis lanceolatis, ca. 4 mm. longis, patentibus; styli ramis hirtellis apice appendice brevissima mucroniformi; antheris basi auriculatis; achaeniis calvis compressis obovatis, apice contractis basi cuneatis, glabris crasse costatis, ca. 1 cm. longis, 5 mm. latis, demum involucrum superantibus.

Plantae primum undique plus minus lanato-tomentosae denique glabriores.

This plant, curious on account of its large akenes, its cymose inflorescence and pinnatisect leaves, has the appearance of an Umbellifer. It seems to be a *Cacalia* allied to *C. cervariaefolia*, which is *Mesoneuris bipinnatifida* Gray. The only important difference from *Cacalia* is the lack of pappus, a character not worthy of generic recognition. Collected on Cerro del Gavilan, Puebla. No. 4113. Type, Herb. Univ. Calif., No. 148805.

Psathyrotes Purpusii sp. nov.

Caulis e radice perenni 5–7 cm. altus albo-lanatus: foliis congestis orbicularibus diametro ca. 2 cm. subtus albo-lanatis supra viridioribus tomentosis, margine crenatis; petiolis ca. 1.2 cm. longis albo-tomentosis: capitibus 1–2 fere sessilibus 1.5 cm. altis: involucrorum squamis anguste oblongis obtusis tomentosis 1–2-seriatis: floribus ca. 25, pallidis vel purpureis: styli ramis linearisubulatis.

This is a very distinct species. It is a small plant with lanate-tomentose stem and leaves. The style branches resemble those

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of *Liabum*, but the involucre is not imbricated and the leaves are alternate. It has the narrow cylindric corollas with short hairy lobes of *Psathyrotes*, but the akenes and texture of the leaves are very different from the desert species of that genus. Perhaps it should be considered the type of a genus. Collected at foot of Sombreritito near Marte, Coahuila. No. 4763. Type, Herb. Univ. Calif., No. 148410.

Perezia Purpusii sp. nov.

Caules ramive purpurei striati glabri vel puberuli; foliis glabris chartaceis oblongis acuminato-dentatis, apice acuminatis, basi auriculato-amplexicaulibus, ca. 6 cm. longis 3 cm. latis, utrinque viridibus reticulato-venosis: capitibus 1–4, caules terminantibus turbinatis, diametro 3 cm., floribus ca. 50 laete purpureis; involucri squamis lanceolatis acuminatis ca. 1.3 cm. longis, margine arachnoideo-lanatis, in bracteas gradatim transeuntibus; pedunculis 4–6 cm. longis bracteosis, bracteis in folios parvos transeuntibus.

The specimens have no roots and few of them are branched. The color of the flowers is similiar to that of purple flowered thistles. Collected at Minas de San Rafael, San Luis Potosi. No. 4787. Type, Herb. Univ. Calif., No. 148464.

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NEW AND NOTEWORTHY CALIFORNIAN PLANTS, I

BY
HARVEY MONROE HALL

As a result of field and herbarium studies on Californian plants, the author has become convinced that many of the so-called "new species" proposed during the last two or three decades are untenable. It is often found that the new proposal either fits exactly into an earlier described species, which has been overlooked or misunderstood, or is connected with it by a series of intermediate forms, the variations being usually the result of adaptations to local environments. However, this naming of ecologic forms as species is not entirely without value, since attention is often thus called to variable characters which might otherwise be overlooked. Moreover, the systematist, who is more concerned with problems of genetics than he is with the naming of new forms, will ultimately be able, as the result of extended field observations and cultural experiments, to reduce these "species" properly to subordinate rank, indicating their relationship by the ordinary methods.

The present paper aims to classify properly a few of these recently described forms and indicate the factors which have probably brought them about. A few new forms are also described. This contribution is offered at the present time to provide for the technical publication of certain new names and combinations. It is desired to use these in a *Yosemite Flora*, now in preparation, but it is believed that most botanists will appreciate the advantage of having them first appear in a more generally accessible publication.

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given as Cuxhaven, on the North Sea shore, Germany. The figure given by Kuetzing in the *Tabulae Phycologicae* (vol. 1, pl. 16, fig. iv, 2) is also good and convincing.

The description given by Johs. Schmidt in Helgi Jönsson's paper on the *Marine Algae of Iceland* (iv, p. 378) is both full and exact. He deals also with the relationship existing between his unnamed variety and the *Pleurocapsa amethystea* of Rosenvinge (*Groenl. Havalger, loc. cit.*, and *Alg. Mar. du Groenl.*, p. 163, fig. 57, 1894). The form on *Rhodochorton Rothii* passes through just such stages as indicated in Rosenvinge's figures but proceeds farther as indicated by Schmidt. The color in the earlier stages is usually more bluish, often deep blue, even at times the bluish purple of the amethyst, but the cell contents of the later stages are a dirty verdigris green. The walls and surrounding jelly are hyaline. The cells become smaller and smaller as division proceeds.

It appears from my own examinations, that this species is probably coincident in its range with its host. In North America it occurs on the north shore of New England (Collins!, Setchell!) as well as on the south coast (Holden!), and on the Pacific coast of North America it ranges from St. Michael, Alaska (Setchell!) down to Monterey, California (Setchell!, Nott!) at least. Especially good colonies of *Pleurocapsa conferta* are abundant in the specimen (of my copy at least) distributed under no. 49 of the *Phycotheca Boreali-Americana* (Nahant, Mass., Setchell!) and fair representatives under no. LVI of the same distribution (Monterey, California, C. P. Nott!).

Brachytrichia Quoyi (Ag.) Bornet is credited to the coast of California by Bornet and Flahault (*Rev. Nost. Het.*, ii, p. 373, 1886,) on the authority of a specimen collected by (or communicated by) Grunow. It seems to have escaped other collectors, so far as I know, at least, but a specimen was collected in August, 1911, by J. E. Guernsey at Laguna Beach in Orange County, California. It seems to be typical and agrees with specimens from the East Indies in habit and structure.

The genus *Coilodesme* was founded by Stroemfelt in 1886 to receive an Icelandic plant to which he gave the name *C. bulligera* (*Algveget Isl., Kuster*, p. 48, pl. 2, figs. 9–12). It was enlarged

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by Kjellman (*Undersök. of såg till Slägt. Adenocytis*, p. 4, figs. 1–8, 1889,) to receive a plant imperfectly described by Ruprecht as var. *californica* under *Adenocystis Lessonii* (*Tange Och.*, p. 291, 1851). A third species was added by De Alton Saunders (*Algae* [*of the Harriman Expedition*], p. 421, pl. 48, 1901), who gave it the name of *C. linearis* but which Setchell and Gardner (*Algae N. W. America*, p. 241, 1903) later identified as the *Asperococcus Cystoseirae* Ruprecht (*Tange Och.*, p. 370, 1851) and changed the name to *C. Cystoseirae*. The genus consequently, has three species attributed to it.

For some time there has existed in my mind a doubt as to the exact identity of *Coilodesme californica* (Rupr.) Kjellm. De Alton Saunders described and figured a plant under this name (*Proc. Calif. Acad. Sci.*, ser. 3, Bot., vol. 1, p. 160, pl. 29, figs. 1–3, 1898) which is common on the coast of California on *Cystoseira Osmundacea*. It is a plant which often reaches a large size, is cylindrical at first, but collapses more or less later, is thin walled and wrinkled. Its color is light yellowish brown, changing often to an olive green in drying. It has been distributed in Collins Holden and Setchell, *Phycotheca Boreali-Americana* under no. I, and in Tilden's *North American Algae*, under no. 354.

There is, however, still another species of *Coilodesme* existing on the coast of California and also found growing upon the fronds of *Cystoseira Osmundacea*. This species never reaches the size of the last, is smooth, firm, comparatively thick-walled, strongly flattened, and of a dark brown color, even from the first. It looks very much like *Halosaccion fucicola*, but is brown and flattened. On comparing the descriptions of Ruprecht (*loc. cit.*) and of Kjellman (*loc. cit.*), it seems fairly certain that it is this flattened, smooth, dark brown plant which is to be referred to *Coilodesme californica*, leaving the ample, thin, wrinkled, and lighter colored plant as an undescribed species. The four species of *Coilodesme*, thus distinguished, may be arranged as follows:

FRONDS FLATTENED, LONG STIPITATE, FIRM, DARK BROWN

1. *C. bulligera* Stroemf. More or less swollen and bullate, especially on the edges.
   Stroemfelt, Algveget. Isl. Kuster, p. 48, pl. 2, figs. 9–12, 1886.
   Phycotheca Boreali-Americana, no. 923, 1902!

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2. *C. californica* (Rupr.) Kjellm. Flattened and smooth on the edges, not at all swollen.

Ruprecht, Tange Och., p. 291, 1851 (sub *Adenocystis* (*Lessonii* var.?) *californica.*)

Kjellman, Undersökn. af någ. till Slägt. Adenocystis, p. 8, figs. 1–8, 1889.

FRONDS INFLATED, VERY SHORT STIPITATE, CYLINDRICAL, WRINKLED, THIN AND MEMBRANACEOUS, LIGHT BROWN

3. *C. Cystoseirae* (Rupr.) Setchell & Gardner. Elongated, narrowly cylindrical.

Ruprecht, Tange Och., p. 370, 1851 (sub *Asperococcus Cystoseirae*).

Saunders, Algae (of the Harriman Expedition), p. 421, pl. 48, 1901, and in Phycotheca Boreali-Americana, no. 824, 1901 (sub *Coilodesme linearis*).

Setchell & Gardner, Algae N. W. America, p. 241, 1903; Phycotheca Boreali-Americana, no. 1128, 1903.

4. *C. amplissima* sp. nov. C. thallo amplo, ad 30 cm. alto et 7.5 cm. lato, late cylindrico, apice obtuso rotundatoque, basi contracto brevissimo-stipitatoque, cavo, primum inflato demum collabente, irregulariter undulato, luteo-fusco; parietibus tenuibus, membranaceis.

Saunders, Proc. Calif. Acad., ser 3, Bot., vol. 1, p. 160, pl. 29, figs. 1–3, 1898; Phycotheca Boreali-Americana, no. I, 1899 (both sub *C. californica*).

Tilden, Amer. Algae, no. 354, 1900 (sub *C. californica*).

From Yakutat Bay, Alaska (Saunders) to San Pedro, California (Mrs. S. P. Purdy!), growing on *Cystoseira Osmundacea* and *Cystophyllum geminatum.*

There is little need for giving a detailed description of *C. amplissima,* since it is really the plant better known than *C. californica.* The figure of Saunders, and the specimens distributed, make plain what is meant. By the thinness of its membrane, lack of flattening, particularly in the early stages, its very short stipe (2 mm. or less), it is clearly allied to *C. Cystoseirae* and quite distinct from *C. bulligera* and *C. californica.* In distribution on the Pacific coast of North America, *C. bulligera* and *C. Cystoseirae* occupy the northern portion, while *C. californica* and *C. amplissima* occupy the southern portion. It may be that *C. amplissima* will be found to pass over into the forms of *C. Cystoseirae* (cf. Setchell & Gardner, *loc. cit.*, p. 241), but it seems best to keep it distinct at present.

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HAPTEROPHYCUS Setchell et Gardner gen nov. Ralfsiacearum

Frons decumbens, dorsiventralis, orbicularis; ramis e centro radiantibus, obesis, curtis, dichotomo multiplo ramosis, infra canaliculatis, marginibus crenatis, axillis latis rotundisque, apicibus latis obtusisque; soris sub cuticulo orientibus mox superficialibus, latis et inconspicuis; sporangiis (unilocularibus) pyriformibus, lateralibus in cellulis basilaribus paraphysium multicellularum multo superantium; intus frons cellulis magnis, cylindricis, hyalinis, in seriebus ad superficiem e planitie horizontali media utrinque curvatis, compositis; cellulis superficialibus parvioribus endochromatibus farctis; gametangiis ignotis.

H. canaliculatus Setchell and Gardner sp. nov.

Frondibus ad 5 cm. latis, luteo-fuscis; sporangiis 65–75μ longis, 18–25μ latis; paraphysibus 4–7-cellularibus, 6–7μ latis. In saxis, intra limites fluxuum maris, apud "San Pedro," in ditione Californiensi, ubi detexit N. L. Gardner.

The new genus and species here proposed was found by Dr. N. L. Gardner, growing on rocks in the litoral zone in the neighborhood of San Pedro, California. On the rocks it looks so much like the holdfasts of some member of the Laminariaceae, that it seems fitting to choose for it the generic name given above. Radiating from the center, the short, stout, dichotomous branches, with broad rounded axils and broad, blunt tips (pl. 25, figs. 1 and 2) counterfeit the hapteres of such a kelp as *Egregia Menziesii* or *E. laevigata* most exactly. The texture is firm and the color, when young, a light yellow brown, darkening with age or on drying. The inner structure is parenchymatous and very much like that of *Ralfsia deusta*. The rows of cells, as seen in section, curve from a middle plane towards each surface (pl. 25, fig. 3). The meristematic region for increase in length is broad and situated at the ends of the branches. The sori, containing the sporangia, are broad and make no visible sign of their presence. They consist of pear-shaped unilocular sporangia which are borne on the same basal cells with the multicellular paraphyses which far overtop them (pl. 25, fig. 4). At first the sorus is covered by the cuticula, but this is soon sloughed and the paraphyses are uncovered (pl. 25, fig. 3.) No sign of gametangia (plurilocular sporangia) has been seen in any of the specimens

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examined. The plants are only loosely attached to the substratum and the branches are channeled below (pl. 25, fig. 2).

The genus *Hapterophycus* must belong in either the Ralfsiaceae or the Chordariaceae, as at present understood. Perhaps these two orders should be united. If kept separate, the affinities of *Hapterophycus* seem clearly with the Ralfsiaceae, differing only from the genera now included in that order by the branches being free instead of completely (or nearly completely) coalescent. In fact, *H. canaliculatus* has many points in common with *Ralfsia deusta,* whose loose attachment to the substratum and imbricated and often deeply lobed margins seem to connect the genus *Ralfsia* with *Hapterophycus.* There is a certain superficial resemblance between *H. canaliculatus* and *Cylindrocarpus Berkeleyi,* but the microscopic structure of the two species is quite different. *Hapterophycus* has also some considerable resemblance to the basal portions of *Analipus* and *Caepidium,* but is certainly not identical with either of those genera.

Callymenia oblongifructa comb. nov.

Iridaea oblongifructa Setchell. Notes on Algae I., Zoe, vol. 5, p. 123, 1901; Setchell & Gardner, Algae Northwestern America, p. 300, 1903.

When in 1901 I described a plant sent by N. L. Gardner from Whidbey Island, Washington, as *Iridaea oblongifructa,* I relied upon the habit and the internal structure to refer it to the genus *Iridaea.* The cystocarp also seemed more diffuse, like that of *Iridaea* rather than of *Callymenia.* I did not, at that time, observe the procarps, nor did I find the tetrasporangia. In 1903 Gardner and myself, in publishing our "Algae of Northwestern America," expressed the opinion that it might be a species of *Callymenia.*

Since then, I have been able to examine other specimens and to make further studies, with the result that I am certain that the species must be removed from *Iridaea* into *Callymenia,* where it forms a distinct species.

Callymenia oblongifructa, even yet, is a very little known plant. It is usually obtained in fragments, often of large size, but still incomplete. Young plants, seemingly of this species,

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have been collected, but, since they are sterile and much thinner than the adult type, their identification is not so certain as could be desired.

In general, it seems certain that *C. oblongifructa* has the habit and appearance of a species of *Schizymenia* or of *Dilsea*. Arising from a broad fleshy disk, the plant soon broadens to ovate or even to cordate, and then grows on into a frond which is much longer than it is broad. It certainly reaches a length of 75 centimeters and a breadth of at least 30 centimeters. As the plants giving these measurements were fragments of a larger plant, it seems equally certain that plants must exist with measurements even considerably greater than these. At first the frond is undivided, but later splits to the very base.

The texture is firm and membranaceous when dry, becoming more or less fleshy when the dried plant is soaked in fresh water. Some individuals deliquesce more or less completely after a time in the "soaking out" process, but others remain intact. The color varies from dark red to light red, but the latter color seems to belong particularly to "weathered" specimens. The surface is very delicately marked by coarse but very slightly elevated wrinkles running out flabellately from the base. This character of the surface, while slight and often obscure, often serves to identify a sterile specimen. The thickness of the adult frond varies in the same frond from about 210μ to 550μ, but large specimens, which are however still young, are often not over 150μ or 200μ in thickness. On account of the delicate wrinkling, the thickness varies considerably in the same frond and within short distances.

The internal structure has a certain fairly close resemblance to that of true species of *Iridaea*. It varies somewhat, according to age and condition, and such variation may be found even in the same frond. The general course of the slender (or, at times, coarser) filaments of the medulla is longitudinal, but there are oblique cross connections at frequent intervals making more of a reticulum, or at least a looser one, than is usual in species of *Callymenia*. The cortex on each side is thin, as compared with the medulla. It consists of about five layers of cells loosely but regularly placed in the surrounding jelly, and decreasing in size,

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while increasing in color, as they approach the surface. A fairly thick and transparent cuticula clothes the surface.

The cystocarps are broad and deep-red, a very little, and equally, prominent on both surfaces. The "nuclei" or spore clusters are small and well separated from one another. Procarpic branches are fairly abundant and easily detected. In addition to the procarp, they consist of about five cells much elongated laterally and of the general character of those of *Callophyllis* (cf. Hauptfleisch in Engler & Prantl, *Die natürl. Pflfam.*, 1 Th., Abth 2, fig. 220D, 1896) and of *Erythrophyllum* (cf. Twiss, *Univ. Calif. Publ.* Bot., vol. 4, pl. 24, fig. 11, 1911). The structure of the procarpic branch assists very materially in deciding the position as between *Iridaea* and *Callymenia*.

The tetrasporangia are scattered through the cortex and occur in plants somewhat thinner (400–420μ thick) on the average than the cystocarpic plants. They are oblong, 18–21μ high by 14–16μ broad, and are divided in the tripartite-cruciate fashion.

C. oblongifructa differs from all the other species of *Callymenia* known from our western coasts in habit, color, thickness, and details of internal structure. It belongs to the section of the genus, to which J. G. Agardh (*Anal. Alg.*, p. 65, 1892) assigned the name *Euhymenia*, so far as internal structure is concerned and the position and influence of the cystocarp on the frond is concerned. It differs sufficiently from all the species of that section, however, in its simple habit to render farther comparison unnecessary.

C. oblongifructa has been found on the shores of Whidbey and San Juan Islands in the State of Washington as well as near Sitka, Alaska, by N. L. Gardner, and near Seldovia, Alaska, by C. V. Piper.

BESA gen nov. Gigartinacearum

Frons epiphytica (aut hemiparasitica), elongato-papillaeformis aut clavata, simplex aut parce lobata, laete rubra, cystocarpiis adultis frondem fere complentibus, nucleis distinctis multis per cellulis sterilibus magnis segregatis compositis, carpostomio proprio nullo; antheridiis tetrasporangiisque adhuc ignotis.

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B. papillaeformis sp. nov.

Frondibus gregariis aut sparsis, 0.28–0.48 mm. altis et ad 0.38 mm. latis, carnoso-cartilagineis et in frondibus crustaceis rubris Hildenbrandtiae(?) epiphyticis (aut hemiparasiticis).

In zona litorali, apud San Francisco, in ditione Californiensi, ubi detexit W. A. Setchell.

It has seemed best to name this extremely minute plant after the Egyptian god Bes, whose Greek name Βῆσα has been adopted into Latin unchanged. He is always represented as a dwarf and extremely small even at that.

I first detected this plant growing in small groups on a crustaceous red alga, probably a species of *Hildenbrandtia*, which covered the rocks in the upper middle litoral zone at the locality known as Land's End, at the northern extremity of San Francisco, California, in January, 1909. Its color is very slightly lighter than that of the *Hildenbrandtia* on which it is growing and it is due to this fact that it attracted my attention.

The fronds are simple and clavate or somewhat compound, being more or less deeply lobed as shown in plate 25, figure 5. They do not reach a height of much over half a millimeter at most. They are attached to the substratum by a broad base (pl. 25, fig. 6), whose basal cells have protoplasmic connection with the cells of the host plant. The development of *Besa papillaeformis* begins, and progresses for a short time, under the cuticula of the host, at length breaking through. The cuticula of the host may be seen in sections of the adult specimens still covering the bases at the sides (pl. 25, fig. 6). It is this behavior of the plant in breaking through the cuticula, as well as the difference in the consistency and cell structure of the papilliform body, which leads me to regard it as a hemiparasite and not as the fruiting body of the crustaceous red alga upon which I have always found it growing. This crustaceous red alga seems, from its structure, to be a species of *Hildenbrandtia*, but I have not been able as yet to find any fruiting bodies of any sort upon it.

The young and sterile plants are slender and cylindrical or clavate, while the cystocarpic plants are swollen above and come to be obovate. In the older plants, the central cells are elongated and the central strands become almost filamentous.

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Procarps are very abundant in plants of the proper stages of which I have observed a few. They are simple, curved, of about three cells ending in a long trichogyne. The basal cell probably functions as an auxiliary cell, but the details of development have not been traced.

The cystocarps are large for the size of the plants and come to occupy the greater part of it. They are the typical "compound cystocarps" of the Gigartinaceae and are well represented in figure 6 of plate 25. The various spore masses are separated from one another by large sterile cells and there is no distinctly marked-off and special enveloping tissue. The whole structure of the plant, of the cystocarp, and of the procarp, indicate that *Besa papillaeformis* is to be placed in Gigartinaceae, under the family Gigartineae, and near the genus *Gigartina* itself.

There is a certain resemblance in habit (taking plant and host together) to *Dermocorynus Montagnei* Crouan, but the resemblance apparently stops there, since that species is described as having the structure of frond and cystocarp of the Grateloupiaceae.

Thus far I have detected *Besa papillaeformis* only at the single locality mentioned above, but I have collected it there on several different occasions. It will probably be found in other similar situations on the coast of middle California at least, escaping notice on account of its microscopic size.

Fauchea laciniata forma **pygmaea** Setchell et Gardner, forma nova

F. laciniata forma colore et structura frondis cystocarpiorumque ut in planta typica sed frondibus pygmaeis, 1–3 cm. altis, rosulatis, compactis, et condensatis; cystocarpiis numerosissimis, in paginis utrisque aggregatis; nematheciis efformatis, latis.

In corallinaceis articulatis, in zona litorali inferiore apud "San Pedro," in ditione Californiensi, ubi detexit N. L. Gardner.

It seems proper to call attention to, and to bestow a name upon a set of plants which seem clearly to belong to *Fauchea laciniata*, but which possess a particular and distinctive habit due apparently to their environment. These plants are very

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much dwarfed and compacted into rosulate tufts. The thallus is condensed, so that the branches are shorter and the whole habit more compact. There seems to be no particular distortion, and the microscopic structure seems entirely normal. The dwarf plants show abundant cystocarps, which are coronate and very thickly placed on both surfaces. I have seen only a few tetrasporic plants. They are small (about 1 cm. high) and the nemathecia resemble those first formed in typical *F. laciniata*, being broad patches but without any regular or fixed outline or arrangement.

The f. *pygmaea* grows chiefly on jointed corallines which form a zone at the lower tide mark or just below. They have other dwarf (or dwarfed) forms on them and are accompanied by pigmies of other algae as well, thus making a characteristic formation. The *Fauchea(?) mollis* Howe alluded to below may possibly belong to this form, although its being sterile seems to indicate, rather, that it may more likely prove to be a juvenile state of *F. lacinata*.

Fauchea Fryeana sp. nov.

F. fronde solitaria (aut caespitosa?), usque ad 34 cm. diam., in circumscriptione late aut moderate reniformi, vinoso-rubra, cartilagineo-membranacea, e disco radicali; stipite brevi, ad 12 mm. alta; fronde ampla, flabellatim expansa, e basi et superne repetite dichotomo-dissecta; segmentis inferne lente attenuatis, inferioribus latioribus, superioribus angustioribus, ultimis numerosissimis, acutis, lateraliter grosse dentatisque; fronde 100–360μ crassa, stratis tribus composita,—strato medullari cellulis magnis in centro extus parvioribus, stratis corticalibus duobus. cellulis, parvis, elongatis, coloratisque, sphericis, in seriebus anticlinis moniliformibusque dispositis; tetrasporangiis in nematheciis indefinitis sed elongatis flabellatim radiantibusque, in partibus inferioribus, triangulo divisis, paraphysibus multicellularibus superantibusque comitatis, omnibus in gelina crassa hyalinaque involutis; antheridiis adhuc ignotis; cystocarpiis margines segmentorum omnium majorum occupantibus, dense confertis, urceolatis, apice quoque in collo longo attenuato, intus placentis basilaribus nucleos sporarum conglobatarum gerentibus, pericarpiis intus filamentis late reticulatis compositis, peristomiis latis.

In zona sublitorali, "Friday Harbor" et vicinis, in ditione Washingtoniensi, ubi detexerunt Prof. T. C. Frye et Dr. N. L. Gardner.

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There are already two species of this genus known from the same general region as the one described, viz., *Fauchea laciniata* J. Ag. and *F. Gardneri* Setchell. *F. Fryeana* differs from both of these in both the cystocarpic and the tetrasporic plants. *F. laciniata* belongs to the section of the genus having coronate cystocarps. They are also scattered over both surfaces of the frond. The nemathecia in *F. laciniata* are also different, at least in general aspect, from those of *F. Fryeana* (cf. Setchell & Gardner, *Algae of Northwestern America,* pl. 19, fig. 30, 1903). The type of *F. laciniata* in Herb. J. Agardh, at Lund, is from Santa Barbara. It is cystocarpic and the cystocarpic specimens from Puget Sound have been compared with it and agree closely. *F. Gardneri* has cystocarps which lack a corona, but they are also scattered over both surfaces of the frond. The nemathecia of *F. Gardneri* are small and irregular in shape and scattered over both surfaces in a grapheiform fashion (cf. Setchell & Gardner, *loc. cit.,* pl. 25, fig. 43). The cystocarps of *F. Fryeana* are strictly marginal and so closely placed that they give the margins a decidedly fimbriate appearance (cf. fig. 13, pl. 31). They are sometimes, also, situated in short and slender process projecting a few millimeters from the margin in older (or at least larger) plants, and when this condition is present it heightens the fimbriate appearance.

Howe (*Bull. Torrey Botan. Club,* vol. 38, p. 506, pl. 31, 1911) has just described a new species of *Fauchea,* under the name of *F. Sefferi,* which has marginal cystocarps which are not coronate, and this species is to be most seriously considered in comparison. It is very much narrower than any specimens of *F. Fryeana* seen among our specimens, is of entirely different aspect, and is more striking in its dichotomy, characters which, from the study of a considerable variety of *Fauchea* material, appeals to me as being reasonably constant. Unfortunately, Howe did not have any tetrasporic plants of his species, so that full comparison cannot be made. This is to be regretted, since, in our Pacific Coast species, the character of the nemathecia assist greatly in identification. It seems, however, perfectly safe to consider our plant as being quite distinct from the *F. Sefferi* of California Baja.

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Young and tetrasporic plants of both *F. laciniata* and *F. Gardneri* are broader, thinner, brighter or deeper colored than older and cystocarpic plants. The tetrasporic plants of *F. Fryeana* (cf. fig. 14, pl. 31) are mostly very young or, even the oldest of them, not very old. They resemble in habit and characters of thickness the *Fauchea(?) mollis,* described from young, sterile specimens by Howe (*loc. cit.,* p. 507, pl. 32; pl. 33, fig. 6). The young plants of *F. laciniata* also resemble in habit characters *F.(?) mollis.* It will be impossible to determine definitely just what *F.(?) mollis* really is until it has been traced into its adult forms. If it should happen that *F.(?) mollis* prove to be identical with any one of the three species of the coast of the United States, it seems not unlikely, since several of the species described by Howe from La Paz are found also on our Southern California coast, that it may prove to be a young plant of *F. laciniata,* whose type locality is Santa Barbara, California, rather than either one of the other two, which, thus far at least, have been found only in the colder waters of Puget Sound. In thickness and structure of the frond, young plants of *Fauchea laciniata* agree exactly with the descriptions of *F.(?) mollis,* while young plants of *F. Fryeana* differ only in the more distinctly anticlinal rows of the cortex. In structure and habit, young plants of *F. Gardneri* are decidedly different from *F.(?) mollis.*

It seems best, after due consideration, to propose *Fauchea Fryeana* as a new species, as was done by letter some several years since, and to name it in honor of Professor T. C. Frye of the University of Washington, who sent me the first specimens. The types are deposited in the Herbarium of the University of California and the type locality is Friday Harbor, Washington, whence also have come fine typical specimens of *F. Gardneri* and of *F. laciniata.*

Dudresnaya caribaea (J. Ag.) comb. nov.

Calosiphonia caribaea J. G. Agardh, Analecta Algologica, cont. v, p. 84, 1899.

In working over some very interesting red algae, found floating in abundance at Coopers Island in the Bermuda Islands, by W. G. Farlow, in 1881, I found three species, two of *Dudresnaya*

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and one of *Calosiphonia,* which had so general a resemblance in habit and color to one another that it was difficult to be certain, at least at first, that they could be distinct species. The microscopic structure, especially of the cystocarps and procarps, however, is sufficiently, in fact amply, distinct. A comparison with types and careful study has enabled me to enumerate and describe them in this paper with some considerable degree of confidence as to accuracy.

One of the plants corresponds exactly to the type specimen of J. G. Agardh's *Calosiphonia caribaea,* but is referable to the genus *Dudresnaya,* as indicated above.

Dudresnaya caribaea (J. Ag.) has solitary (or possibly slightly aggregated?) fronds, of a light or yellowish red color and broadly flattened ovate outline. From the discoid (or possibly expanded?) base arises a single stem which, usually, at any rate, soon loses itself in several main branches. The branches are more or less strongly complanate and pinnately distichous (or at times more or less secund); the branches themselves, being branched in turn, conformably twice (or rarely thrice) more. All the branches and branchlets taper towards each end, the ultimate branchlets being fusiform (Pl. 26, fig. 7). The structure of the frond is almost exactly that of *Dudresnaya purpurifera* J. Ag. The peripheral filaments are strongly moniliform, the cells being oblong or obovate and deeply constricted at the nodes, di- to trichotomous below but only dichotomous above. I have not been able to detect tetrasporangia on any of the available specimens, and the species seems to be partially dioecious. Some specimens are smaller and paler, and have the peripheral cells over considerable areas, pale and rounded, as well as apparently discharging their contents. However, it is not certainly to be determined from dried specimens. Other specimens appear to have both antheridia and procarps on the same plant.

The procarps and auxiliarly branchlets closely resemble those of *Dudresnaya purpurifera* J. Ag. Both sorts of branchlets are strongly curved, situated in the outer third of the verticil, and consisting of nine to fourteen cells. In the procarpic branch, the cells are discoid supporting a conical carpogonium which, in turn, is prolonged above into a moderately long, more or less spirally

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twisted, slender trichogyne. The auxiliary branches appear to be much more numerous than the procarpic, which they resemble closely, except that the terminal cell is enlarged into a nearly spherical auxiliary cell. The cystocarps are moderate sized, from 45–90μ in diameter, consisting of few spores, successively formed and closely crowded together.

Dudresnaya caribaea is closely allied to *D. purpurifera,* but is to be distinguished from it by its complanate frond, its much more distichous method of branching, and its rather larger, fewer spored cystocarp.

In Herb. J. G. Agardh, there are two specimens under the name of "*Calosiphonia caribaea* J. Ag.," under nos. 34781 and 34782, both marked also "ex Florida Curtiss." No. 34781 is marked "24" and "Tortugas" in pencil, and no. 34782 is marked "30" in pencil. Both plants are cystocarpic. The "Tortugas," then, off the Florida coast are the type locality. It is rather more than possible, in fact it is fairly certain, that the plants were collected by Mrs. G. A. Hall and only transmitted to Professor Agardh by Mrs. Curtiss. Through the kindness of Professor Svante Murbeck and Dr. Otto Nordstedt I was allowed to make a microscopic examination, with the result that I found both types to belong to the genus *Dudresnaya.* This came as a surprise, since there is a species of *Calosiphonia* from the Tortugas, sent by Mrs. Hall, resembling in habit the present plant, and which appears in Herb. J. Agardh as the type of *Helminthiopsis verticillifera* J. Ag., as will be noted below. The suggestion is natural that the type specimens of these two species may have been transposed by Agardh. However, there are certain indications in Agardh's descriptions that he had correctly labelled his types and that his *Calosiphonia caribaea* is designated as he desired it to be. Particularly his description of the curved moniliform filament from which the cystocarp is produced serves to fix it, as well as his remarks noting its resemblance to the plant which he had long kept in his herbarium under the name of *Dudresnaya australis,* of which I shall give farther information later on in this paper.

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Dudresnaya bermudensis sp. nov.

D. fronde solitaria (aut pauciaggregata), ad 9 cm. alta, ovata in circumscriptione, dilute rosea, gelatinosa; basi discoidea (aut prostrata extensaque?); axe percurrente sed ramis multis et superantibus, lente valdeve complanata, ramosa; ramis plus minusve distiche pinnatis aut secundis, compressa, ipsis 2–3-plo ramuliferis omnibus utrinque lente attenuatis; ramellis peripheralibus intus cylindraceis, extus moniliformibus; tetrasporangiis adhuc ignotis; monoica?, antheridiis(?) parvis, superficialibus, pallidis rotundisque; ramellis procarpiiferis elongatis, multicellularibus, plus minusve curvatis, cellulis discoideis et cellula carpogoniali apicali obtusa conica in trichogynum elongatum spiraliter curvatum desinente compositis; ramellis auxiliaribus elongatis, multicellularibus, simplicibus aut infra 2–3-ramelluliferis, curvatis, cellulis mediis depresso-sphericis, tumefacientibus, similibus; cystocarpiis moderate magnis, 112–126μ latis, reniformibus, integris aut obscure lobatis, pedicellis curvatis suffultis, maturitate non apiculatis.

Rejecta ab undis ad insulam "Coopers," in insulis Bermudensibus, ubi detexit cel. W. G. Farlow, in anno 1881.

The new species here proposed is one of the rich finds made in 1881 by Professor Farlow at Coopers Island, one of the Bermudas. It is of a delicate pink, soft gelatinous, and (so far as available specimens are concerned) of moderate size. In habit (pl. 27, fig. 8) and color, it approximates somewhat to *Dudresnaya caribaea,* but its procarpic and auxiliary branchlets are of the "Coccineae" rather than of the "Purpuriferae." It also has something of the appearance of *D. coccinea,* but is more complanate and distichous. It has also the moniliform peripheral ramelli of *D. purpurifera* rather than the cylindrical ramelli of *D. coccinea.* From *D. crassa,* it differs decidedly in its habit, moniliform peripheral ramelli, and the absence of a single specialized (smaller) auxiliary cell in each auxiliary branchlet. From *D. japonica* it differs abundantly in habit and also very much in the character of the peripheral and auxiliary branchlets, while from the next species *(D. australis)* it differs somewhat in habit and in details of structure of both the peripheral and auxiliary branchlets. It seems to be a distinct species of the *Dudresnayae Coccineae,* and its chief interest lies in the fact that it combines the auxiliary branchlets of the *D. coccinea*-type with the peripheral branchlets of the *D. purpurifera*-type, a fact pointed

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out by Dr. Bornet in a letter to Professor Farlow many years ago. It is also of interest that it occurs in the same restricted locality with *D. crassa* and *D. caribaea.*

Dudresnaya australis J. Ag. sp. ined.

J. G. Agardh in J. Bracebridge Wilson, Catalogue of Algae collected at or near Port Phillip Heads and Western Port (Proc. Roy. Soc. Victoria, new ser., vol. 4, part 2, p. 181, Nov., 1892) nomen nudum; Anal. Alg., cont. v, p. 85, 1899 (cum descr. incompl.)

D. fronde solitaria (aut pauci-aggregata), ad 13 cm. alta, late pyramidali in circumscriptione, rosea, gelatinosa, monoica; basi discoidea (aut prostrata extensaque?); axe percurrente, gracili, tereti; ramis numerosis, quoqueversum exeuntibus, pinnatis, longis, gracilibus, patentibus, utrinque lente attenuatis, ipsis 2–3-plo ramellois, ultimis subulatis; ramellis peripheralibus conformibus, gracilibus, filiformibus, dichotomis, cellulis elongatis compositis; tetrasporangiis zonatis; ramellis auxiliaribus elongatis, cellulis mediis numero 15 proxime, tumefacientibus sed una media conspicue ut cellula auxiliari differentiata, superne ramellosis et deciduis; cystocarpiis, 60–75μ latis, reniformibus, non apiculatis.

Apud Capita Portus Phillipi et apud Portum Occidentalem in Australia, ubi detexit J. Bracebridge Wilson.

While attempting to make a critical study of the Dumontiaceae, my attention was drawn to four magnificent specimens in the Cryptogamic Herbarium of the British Museum of Natural History, belonging to the collection of J. Bracebridge Wilson, and labelled *Dudresnaya australis* J. Ag. Since J. G. Agardh had not published any description of the plant and since no true *Dudresnaya*—in fact, only one other member of the Dumontiaceae, even—was known from the Southern Hemisphere, I took up the study of Wilson's specimen with great interest..

I found that the name, and that only, had been published by Wilson in his Catalogue of Algae collected at or near Port Phillip Heads and Western Port in 1892. I also found the brief mention of the plant, made by J. G. Agardh himself, in the Continuatio V of the *Analecta Algologica* (pp. 84 and 85). Through the courtesy of Mr. A. Gepp, in charge of the cryptogamic collection of the British Museum of Natural History, I was enabled to make a study of the specimens, and later, through

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the courtesy of Professor Svante Murbeek and Dr. Otto Nordstedt, to compare them with the specimens in Herb. J. Agardh at Lund. The latter are three in number and correspond exactly to the specimens in the British Museum of Natural History. The Lund specimens are labelled "*Dudresnaya australis* J. Ag. *ad interim*" in J. G. Agardh's handwriting, together with notes on specimens 34730 and 34731, to the effect that J. G. Agardh had observed in these specimens the same sort of procarpic and auxiliary branchlets described by Bornet and Thuret for *Dudresnaya coccinea*. His note in the *Analecta* also makes it plain that he clearly recognized the plant as a *Dudresnaya*, but was doubtful as to its being distinct from the European *D. coccinea*.

The habit of the plant is very similar to that of *Dudresnaya coccinea*. A glance at the accompanying photograph (pl. 26, fig. 9), which was made from one of the specimens in the British Museum of Natural History through the kindness of Mr. Gepp, will show this. The structure both of the peripheral and the auxiliary filaments, however, is not that of *D. coccinea*, but very much like that of *D. crassa* as illustrated by Howe and as shown in specimens distributed by him, especially in specimens preserved in formalin, for which I am very much indebted to his kindness. The peripheral filaments are longer than those of *D. coccinea* and the auxiliary branches differ in several respects. In the first place they are very long, apparently much longer than either those of *D. coccinea* or of *D. crassa*. At the base there is a long cylindrical portion, then in the middle about fifteen swollen cells, one of which is wider and more flattened than the others, functioning as the auxiliary cell, and above this a long and generally two or three times dichotomous sterile portion. This terminal sterile portion seems to drop off, or separate, about, or possibly even before, conjugation. *Dudresnaya australis* is plainly monoecious, the antheridia being very similar to those of *D. coccinea* as figured in Bornet and Thuret's *Notes Algologiques* (pl. xi, fig. 2).

Both tetrasporic and cystocarpic plants are represented among the plants at Lund and at London. The tetrasporangia are zonate, as are those of *D. coccinea*, the only other species of the genus in which they have as yet been found.

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It is with some hesitation that I take this name of J. G. Agardh and publish it after his death. He had evidently refrained from publishing it, but I think that, had he been able to go over the recent additions to the genus and to have compared the various species that we now know, his judgment would have been to publish his *D. australis.* In examining the Schmitz collection of slides in the British Museum of Natural History, I find two of *D. australis,* but Schmitz made no mention of this species of the Southern Hemisphere in his account of *Dudresnaya* in the *Pflanzenfamilien.*

Calosiphonia verticillifera (J. Ag.) comb. nov.

Helminthiopsis verticillifera J. G. Agardh, Analecta Algologica, cont. v, p. 98, 1899.

Plant single, or few together, from a discoid(?) base, rising up to 25 or 30 cm. in height, bushy, more or less broadly pyramidal in general outline, rose red, moderately gelatinous, with occasionally small and scattered deposits of lime; main axis more or less distinct, at times becoming indistinct above or losing itself in several main branches, slightly above the base, all of which are nearly equal in growth; axis and main branches slightly to strongly flattened below and distichously pinnately branched from the margins in the lower part, but becoming polystichous above, especially near the tips; branches of three to four orders, slightly attenuated towards each end, those of the last order fusiform; tetrasporangia unknown as yet; antheridia and cystocarps apparently on different plants; antheridia scattered over the entire surface of the antheridial plant which is paler in color than the cystocarpic; cystocarps minute, 35–45μ in diameter, ellipsoidal, of few (12–15) spores, embedded in a transparent jelly which extends out on all sides beyond the spores, with a short cylindrical cell as a pedicel, loosely and irregularly scattered through the inner cortex, each beneath a minute carpostome.

Tortugas, *Mrs. Curtiss!;* Coopers Island, Bermuda, *W. G. Farlow!.*

The *Helminthiopsis verticillifera* of J. G. Agardh is one of the most beautiful of the Red Algae, and as J. G. Agardh says

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(*loc. cit.*), it resembles in color and general appearance some of the forms of *Halymenia Floresia* (pl. 28, fig. 10). In structure, however, it is entirely different. The frond develops from a nearly hemispherical apical cell, from which cells are cut off by successive horizontal partitions. Vertically oblique walls, in turn, cut off four lateral cells from one of the subapical cells, and these in turn develop into a whorl of four ramelli, 3–4-chotomous below and dichotomous above. The resulting plant has a monosiphonous axis giving off successive whorls of ramelli whose ultimate segments combine to form a sort of cortex. The structure is very similar to that of *Calosiphonia Finisterrae* as represented by Bornet and Thuret in the *Notes Algologiques* (cf. pl. xii, figs. 1–3).

What seem to be antheridial plants differ from the cystocarpic only in being lighter colored. The antheridia are scattered more or less, uniformly over the surface, being borne singly or in pairs at the tips of the peripheral filaments. The antheridia are nearly globular and colorless.

The procarps and auxiliary cells were not seen. The cystocarps occur irregularly scattered and just under the periphery. They are very small and ellipsoidal and surrounding a thick layer of transparent jelly. Each cystocarp is supported on a short cylindrical cell and lies in a pear-shaped cavity which opens outward through the cortex by a small pore.

The type of the genus *Helminthiopsis,* as distinctly stated by J. G. Agardh, is *H. verticillifera.* But this species seems to fulfill all the proper requirements to be admitted to the genus *Calosiphonia.* If this view is correct, as it seems to me to be, the genus *Helminthiopsis* falls and is to be deleted. However, J. G. Agardh described a second species (*loc. cit.*, p. 98), founded upon an Australian plant, which he named *H.(?) rosea.*

The type of *H.(?)* rosea is a single specimen, no. 31989 of Herb. J. Agardh at Lund. It was collected at Port Phillip Heads, Victoria, Australia, by J. Bracebridge Wilson on January 23, 1886. It is extraordinarily unlike *H. verticillifera,* both in habit and structure. It is a very small plant of a rosy red color, having a central strand of slender vertical filaments which give off horizontal moniliform ramelli. The cystocarps are small

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with a circle of overarching bracteoid filaments. I have not made a sufficiently careful study to speak with certainty, but it seemed to me, while examining it, to be a species of *Helminthocladia,* in all probability.

BAYLESIA, gen. nov. Dumontiacearum

Frons anceps, e disco radicali erecta; axe principali elongata, pauciramosa, ramis elongatis, axe ramisque pinnis brevibus distiche et conferte ramulosis plumosis vestientibus; axe principali, ramis, ramulisque a cellula apicali orientibus e qua axibus monosiphoneis, ramellis peripheralibus verticilliter positis, et filamentis descendentibus orientibus; tetrasporangiis antheridiisque adhuc ignotis; procarpiis et cellulis auxiliaribus in ramellis propriis curvatisque positis; cystocarpiis reniformibus, integris aut lente sublobatis, pedicellis curvatis suffultis.

Genus ad Pikeam vergens, sed per ramulos fertiles non tumefacientes distinguendum et in honorem Dominarum Bayles nominatum.

B. plumosa, sp. nov.

B. fronde solitaria(?), e disco radicali, ancipite, elongata, vinoso-rubra, erecta, ad 60 cm. alta, parce ramosa, ubique distiche pinnato-plumosa, ramis paucis elongatis, conformibus, ramulis plumosis, numerosis margines axis ramorumque dense vestientibus, ipsis curtis dense et distiche ramulosis; cystocarpiis in ramulis non tumefacientibus.

Infrequens,, rejecta ab undis, prope "Monterey" in ditione Californiensi, ubi detexerunt Dominae A. et A. Bayles, Domina J. M. Weeks, Doctor C. L. Anderson, et W. A. Setchell.

For many years there has been great confusion in the plants placed under the name of *Pikea californica* Harv.,—in fact, Harvey himself founded the species upon two different plants at least. One, however, seems to stand out as the type and that is the plant distributed under no. 897 of the *Phycotheca Boreali-Americana.* Harvey, however, evidently founded his species partly on the plant we now call *Farlowia mollis. Pikea pinnata* has also been confused under *P. californica* as have been several other plants, one of which is the plant just described.

Baylesia plumosa seems to be a rare plant, having been found only a few times and then only cast up by the waves. It has been detected thus far only on the shores of Monterey Bay, or immediate vicinity. The attachment is wanting in all but one

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of the specimens I have seen. *Baylesia* is to be distinguished from all the Dumontiaceae closely related to *Pikea,* by the extreme differentiation between the long and the short axes, which gives the plant its particularly plumose appearance. This serves to distinguish it from *Leptocladia* J. Ag. (= *Andersoniella* Schmitz) and *Farlowia,* while from *Pikea* itself it is to be farther separated by the fact that the branchlets containing the cystocarps are not at all swollen. The internal structure resembles that of *Cryptosiphonia* and of *Pikea.* The auxiliary cells are in specialized curved branchlets characteristic of the Dumontiaceae.

I take great pleasure in dedicating the genus created for the reception of this beautiful and rare plant to the Misses A. and A. Bayles of Pacific Grove, California, who have been zealous in their search after rare and beautiful specimens of marine algae and who have always been willing to share with me their choice specimens. I am indebted to them for a fine fruiting specimen of the *Baylesia plumosa.* This is regarded by me as the type and is no. 95043 Herb. University of California. Another specimen (no. 95045 Herb. Univ. Calif.) has been chosen for photographing and representation on plate 29, figure 11, since it is less dense and more suitable for reproduction by photography. I have also been allowed to examine and affix a manuscript name to specimens of *Baylesia plumosa* in Herb. Farlow at Harvard University and in the Herbarium of the New York Botanical Garden. In both cases the specimens were collected on the shores of Monterey Bay, California, by Dr. C. L. Anderson.

Leptocladia Binghamiae J. Ag.

The genus Leptocladia was described by J. G. Agardh in 1892 (*Analecta algologica, Acta. Soc. Physiogr. Lund,* vol. 38, p. 95) from a plant collected at Santa Barbara, California, presumably by Mrs. Bingham. The type and only species, viz., *Leptocladia Binghamiae* J. Ag., is represented by two fragments in Herb. J. G. Agardh at Lund, preserved under no. 28231. They are both cystocarpic. Although neither specimen is in any fashion complete, yet they are both sufficiently perfect and characteristic to be identified with certainty with the plant distributed under no. 700 of the *Phycotheca Boreali-Americana* as *Andersoniella Farlowii* Schmitz.

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Leptocladia Binghamiae is well described and in considerable detail by J. G. Agardh, who lays stress upon a number of characteristic points. He was, however, in very considerable doubt as to the systematic position of the plant but placed it for the time being in his Rhodymenieae, comparing it particularly with *Hymenocladia* and *Plocamium*. De Toni (*Syll. Alg.*, iv, 2, p. 609, 1900) places it in the Family Rhodymeniaceae and the Subfamily Plocamieae. Schmitz does not mention the genus at all in his account of the Rhodophyceae in the *Pflanzenfamilien*. From its possession of specialized curved auxiliary ramelli in the fertile portions of the frond, *Leptocladia Binghamiae* seems to belong to the Dumontiaceae, as now limited, and in the immediate vicinity of *Pikea*, under species of which it may, at times, be found in different herbaria. It may be distinguished from species of that genus (as limited by Schmitz) by having the cystocarps scattered through the upper and not specially swollen or otherwise differentiated portions of the fertile plants. There are other characters, viz: the subdichotomous branching, and the details of structure and development of the cystocarp which distinguish it from the species of *Farlowia*, while it is to be readily separated from species of *Cryptosiphonia* by its complanate and distichously subdichotomous frond.

Andersoniella Farlowii Schmitz is briefly described by him in Engler & Prantl's *Pflanzenfamilien* (1 Th., Abth. 2, p. 520, 1897). The type of Schmitz can be located only by inference. It is, I feel certain, represented by four slides in the Schmitz collection at the British Museum of Natural History, numbered 4.86. The slides purport to have been prepared from no. 28 of Farlow, Anderson and Eaton's *Algae Exsiccatae Americae Borealis*. This number was probably supplied by Dr. C. L. Anderson to Grunow, who, in turn, loaned it to Schmitz. No. 28 of the *Alg. Exs. Am. Bor.* is labelled *Farlowia compressa*, but an examination of different copies shows that the specimens were mixed. There were distributed under this number true *Farlowia compressa* (Herb. Farlow!, Herb. Brit. Mus. Nat. Hist.!, Herb. Univ. Calif.!) and undoubtedly this number was based on the proper plant, but *Andersoniella Farlowii* was also distributed (Herb. N. Y. Bot. Garden!) as well as an undescribed species of

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Leptocladia (to be named *L. conferta* below) in one copy (Ex Herb. Asa Gray in Crypt. Herb. Harvard Univ.!). It seems perfectly possible, then, that *Andersoniella Farlowii* may be found in other regularly issued copies of this distribution. Dr. Anderson also distributed duplicates from his collection with the printed labels of the *Alg. Exs. Am. Bor.*, and this has been a source of confusion in the case of certain numbers.

The four slides in the Schmitz collection, prepared from no. 28 of the *Alg. Exs. Am. Bor.*, represent the plant distributed under no. 700 of the *Phycotheca Boreali-Americana* mentioned above as being the *Leptocladia Binghamiae* of J. G. Agardh. They are not labelled *Andersoniella* by Schmitz, but "*Farlowiella.*" They agree, however, with Schmitz's description of his *Andersoniella Farlowii* and it seems extremely probable that Schmitz, finding *Farlowiella* preoccupied, changed the name in his manuscript, without changing the designation on his slides.

The name for the Californian plant must be *Leptocladia Binghamiae* J. Ag., and it seems as certain as may be made possible that the later *Andersoniella Farlowii* Schmitz is the same plant. It is not uncommon on the coast of Southern California (San Diego, *Mrs. M. S. Snyder!, Will S. Wright!, H. Hemphill!, Miss Minnie Reed!;* San Pedro, *A. J. McClatchie!, Mrs. S. C. Purdy!, W. A. Setchell!;* Ventura, *Mr. Tenney!;* Santa Barbara, *Mrs. Bingham, Dr. and Mrs. L. N. Dimmick!*); and it extends up to Santa Cruz (*Dr. C. L. Anderson!, Dr. W. G. Farlow!*). Both cystocarpic and tetrasporic plants have been found.

Leptocladia conferta sp. nov.

L. fronde gregaria, erecta, e disco radicali, 15–20 cm. alta, atro-rubra, cartilaginea, angusta, complanata, crassa, subdichotomo—ramosa, ramis elongatis ubique ramulis proliferis confertis et fasciculatis apud margines obsitis, obsolete serratis fimbriatisque; strato medullari filamentum monosiphonium crassumque centrale et filamenta descendentia tenuiaque numerosissima ostendente strato corticali filamenta radiantia 2–4-chotomo-ramosa cellularum tenuiorum intus majorum extusque minorum ostendente; tetrasporangiis antheridiisque adhuc ignotis; ramellis auxiliaribus curvatis, e cellulis paucis discoideisque compositis; cystocarpiis immersis, ubique in ramis superioribus non tumefacientibus, reniformibus, profunde paucilobatis, inferne pedicellis curvatis curtisque suppositis; sporis

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in filamentis 2–3-chotomo-ramosis, e cellulis basalibus paucis pallidioribusque radiantibus; carpostomio, ut videtur, nullo.

Hab. in saxis apud oras Californienses meridionales.

Under the name proposed above, I have placed plants which I have observed most carefully at a locality locally known as "Dillon's Beach," situated on the coast of California just north of the mouth of Tomales Bay. I have also collected others at Carmel Bay, near Monterey, California. The species has been collected at Santa Cruz (or Pacific Grove?), California, by Dr. C. L. Anderson and appears in some copies of Farlow, Anderson and Eaton's *Algae Exsiccatae Americae Borealis,* as mentioned above. I have also received specimens from as far north on the California coast as Trinidad Head, whence they were sent by Mr. C. M. Drake. Thus far, then, it seems to be a plant of the middle California coast. *Leptocladia conferta* grows in rather bushy tufts which are dark red and rigid, where shallow pools are left by the receding tide in the lower portion of the litoral zone.

One characteristic feature of this species is the abundance of the fasciculate proliferations. I have visited the locality at Dillon's Beach during most of the seasons of the year and have never, as yet, found any really young plants. All seem older and have few to very many of the characteristic proliferations which give the species its bushy appearance. The specimens are fairly constantly cystocarpic and, although I have had the opportunity of examining several hundred plants, I have found no indication of either tetrasporic or antheridial individuals.

Leptocladia conferta has the complanate frond and the subdichotomous normal branching of *L. Binghamiae,* but the frond of the former is narrower and thicker than that of the latter, less prominently serrate, more cartilaginous, and constantly and, as it seems, characteristically beset with the longer or shorter adventitious proliferations. This habit is well shown in figure 12 of plate 30. The microscopic structure of the two species is very similar, as it is also to that of *Pikea,* differing only in minor details. The cystocarps, too, are very similar in the two species, but in *L. Binghamiae* there is a carpostome present, while there does not appear to be such a structure in *L. conferta.* They both

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agree, however, in having the cystocarps scattered through the upper, not swollen or otherwise modified, portions of the frond.

Weeksia Fryeana sp. nov.

W. fronde ampla, membranacea, late aut anguste reniformi, integre aut parce lobata laciniatave, 30–35 cm. alta, 15–30 cm. lata, roseo- ad purpureo-rubra, marginibus integris, varie et late lobatis, e disco radicali, ut videtur, emergente, stipite obsoleto; f. stratis tribus contexta, strato medullari lato, filamentis crassis granulatisque intertextis, stratis duobus corticalibus intus cellulis majoribus depresso sphericis hyalinisque, extus cellulis parvis coloratisque in seriebus anticlinis curtisque constitutis et cuticula hyalina indutis; tetrasporangiis in cortice immersis, triangulo-divisis; antheridiis(?) superficialibus, effusis, pallidis, in plantis propriis(?); ramellis procarpiiferis elongatis lente curvatisque serie cellularum basi depresso-sphericarum apice tumidarum et unilaterale elongatarum compositis, cellula apicali late conica in pilum longum desinente; ramellis auxiliaribus conformibus sed cellula apicali depresso-spherica; cystocarpiis per stratum corticale dispersis, majoribus, rotundatis, pedicellatis filamentis ooblastematicis e cellulis centralibus radiantibus, ramosis, basi decoloratis, apice laete rubris et in sporis catenatis transformatis; carpostomio inconspicuo, sed, ut videtur, adente.

Rejecta ab undis et in aquis 40 m. in profundo, apud insulas dictas "Orcas" et "San Juan," in ditione Washingtoniensi, ubi detexerunt Prof. T. C. Frye et Dr. N. L. Gardner.

In 1904 there was dredged, presumably in twenty fathoms of water, off Newhall, on Orcas Island, Washington, a small specimen which was sent to me for identification by Professor T. C. Frye of the University of Washington. The plant appeared possibly, but not altogether certainly, to be antheridial. Later a much finer and more perfect plant was sent by Professor Frye, collected at Deer Harbor on San Juan Island, in the same State. This plant has cystocarps and thus it is possible to make certain that it is a member of the Dumontiaceae and constitutes a second and a new species of the genus *Weeksia.*

Weeksia Fryeana is a large plant; probably it will be found to be a very large plant for a red alga, and may have been collected previously under the impression that it belonged to *Schizymenia* or to *Sarcophyllis.* It is to be distinguished from all species of the former genus by its cystocarpic structure and

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development and from all known species of the latter by its habit, more delicate texture, and certain structural details of the procarps and cystocarps.

Like *Weeksia reticulata, W. Fryeana* is of a fleshy consistency and of a light rosy red color very similar to that of *Callymenia reniformis.* Both species of *Weeksia* have the reniform habit of *Callymenia,* especially in older and characteristic forms. *W. reticulata* proliferates from the margin, the proliferations being in turn Callymenioid, but thus far no such process has been seen in *W. Fryeana.* However, as stated above, only a very few specimens and fragments of *W. Fryeana* have been seen. In neither of the species of *Weeksia* are the surfaces smooth and even, both being indefinitely wavy and uneven. In *W. reticulata,* however, as its name indicates, there is a series of broad but obscure veins radiating from the base and forming a coarse reticulation through the middle region of the frond, and vanishing towards the margins. Nothing like this has been seen in *W. Fryeana.*

The few specimens thus seen have come from Orcas Island (T. C. Frye!, N. L. Gardner!), where they have been obtained from deep water. I have also seen and, through the courtesy of Dr. M. A. Howe, have been able to examine a specimen of very considerable interest in the Herbarium of the New York Botanical Garden. It is a specimen with the label-heading: "Herbarium of the U. S. South Pacific Exploring Expedition under the command of Capt. Wilkes, U. S. N., 1838–1842." It is identified as *"Iridaea Mertensiana,"* and was collected somewhere in "Oregon and Washington Territory." The fragment examined shows young procarps and auxiliary branchlets.

Transmitted January 22, 1912.

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EXPLANATION OF PLATES

PLATE 25

Hapterophycus canaliculatus Setchell & Gardner

1. Portion of a thallus seen from the upper side. × 2 diam.

2. Portion of a thallus seen from the lower side. × 2 diam.

3. Vertical section through a lobe of the thallus, showing a portion of a sorus above. × 280 diam.

4. Unilocular sporangium and paraphysis. × 920 diam.

Besa papillaeformis Setchell

5. Portion of the crustaceous thallus of the host, bearing four plants of the hemiparasite. × 60 diam.

6. Median vertical section through a cystocarpic plant and a portion of its host. × 240 diam.

Figures 1–4 were drawn under the writer's direction by Miss Anna Hamilton, and figures 5 and 6, by Mr. W. C. Twiss.

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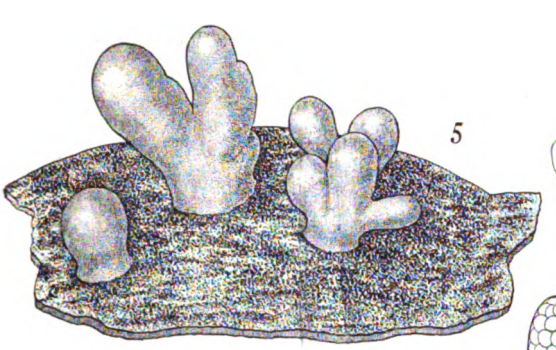
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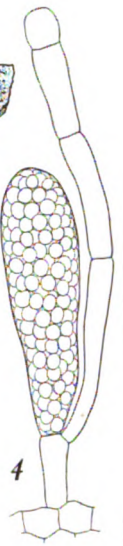
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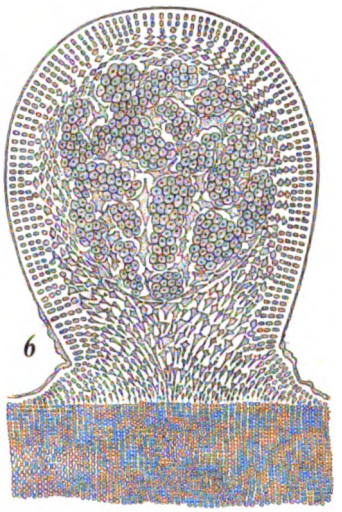
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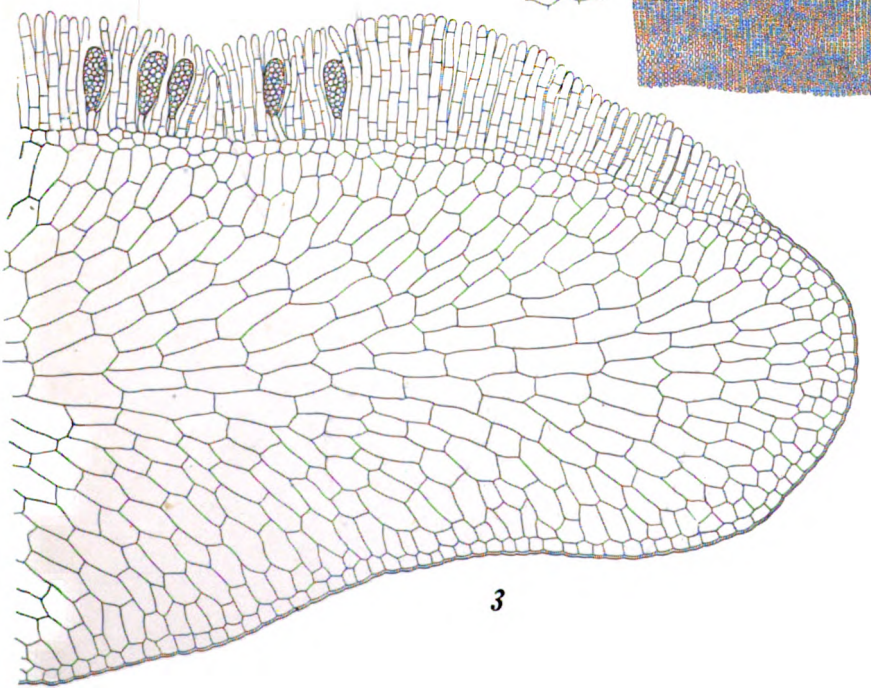
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PLATE 26

Dudresnaya caribaea (J. Ag.) Setchell

8. Habit of the type specimen. × 1 diam.
Photograph, through the kindness of Mr. M. B. Nichols.

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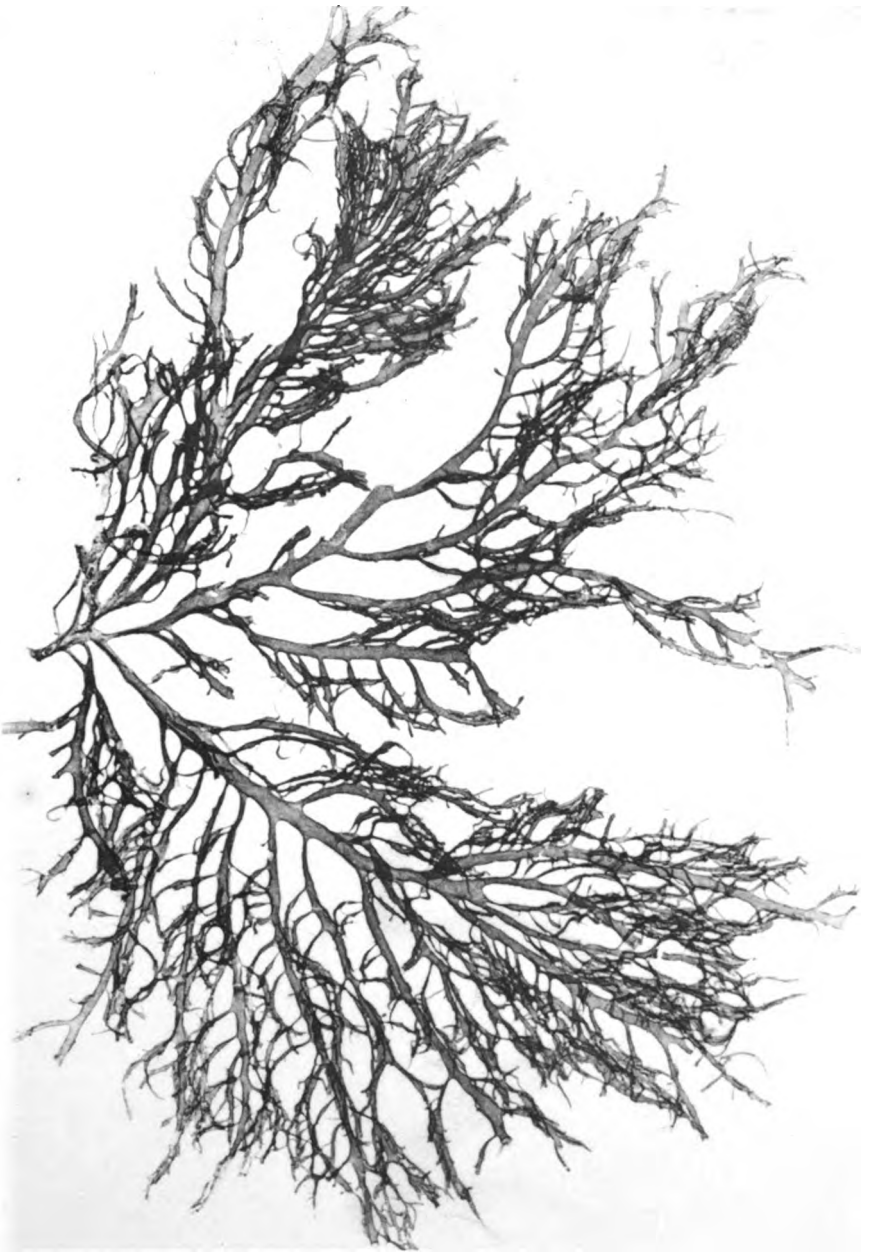

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PLATE 27

Dudresnaya bermudensis Setchell

8. Habit of the type specimen. × $\frac{18}{18}$ diam.
Photograph, through the kindness of Mr. M. B. Nichols.

Dudresnaya australis J. Ag.

9. Habit of a cotype in the J. Bracebridge Wilson collection in the British Museum of Natural History. × $\frac{125}{157}$ diam.

Photograph, through the courtesy of Mr. A. Gepp.

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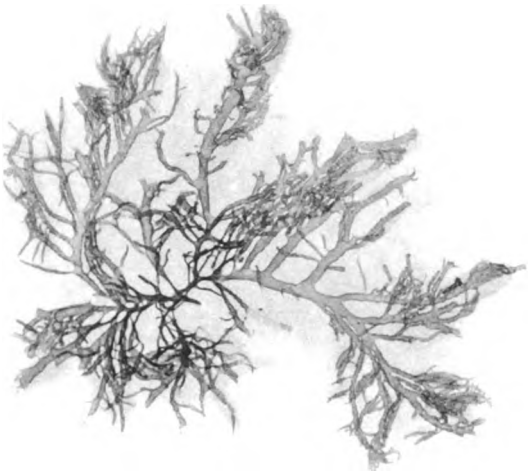

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PLATE 28

Calosiphonia verticillifera (J. Ag.) Setchell

10. Habit of a specimen, collected by Dr. W. G. Farlow at Coopers Island, Bermuda, in 1881. × $\frac{1}{1}\frac{2}{5}\frac{5}{7}$ diam.

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PLATE 29

Baylesia plumosa Setchell

11. Habit of a typical plant, collected at Pacific Grove, California, by W. A. Setchell. × $\frac{2}{3}\frac{2}{7}$ diam.

Photograph, through the kindness of Mr. M. B. Nichols.

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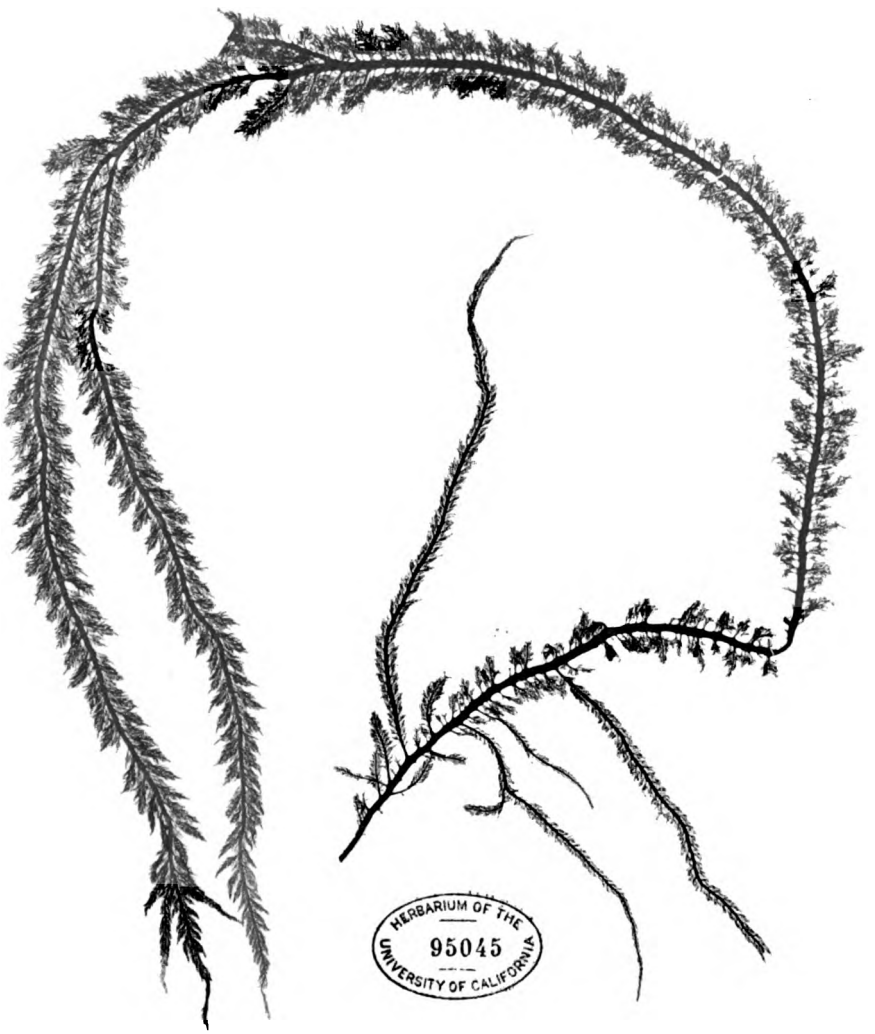

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PLATE 30

Leptocladia conferta Setchell

12. Habit of a typical plant, collected at Dillon's Beach, Marin County, California, by W. A. Setchell. × $\frac{25}{89}$ diam.

Photograph, through the kindness of Mr. M. B. Nichols.

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PLATE 31

Fauchea Fryeana Setchell

13. Habit of cystocarpic type specimen. × $\frac{4}{1\,8}$ diam.

14. Habit of tetrasporic plant somewhat younger than the type specimen, but a cotype. × $\frac{2\,3}{3\,8}$ diam.

Photographs, through the kindness of Mr. M. B. Nichols.

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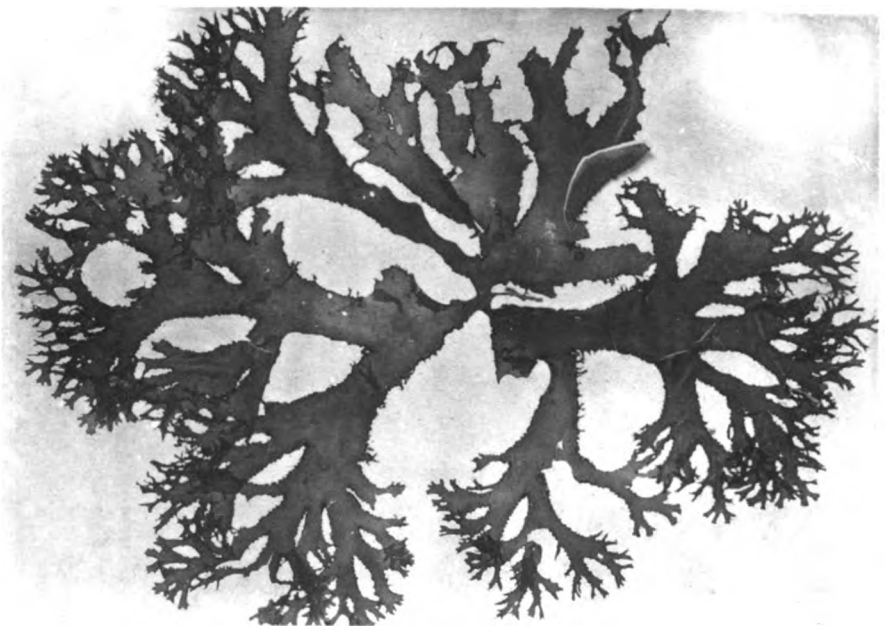

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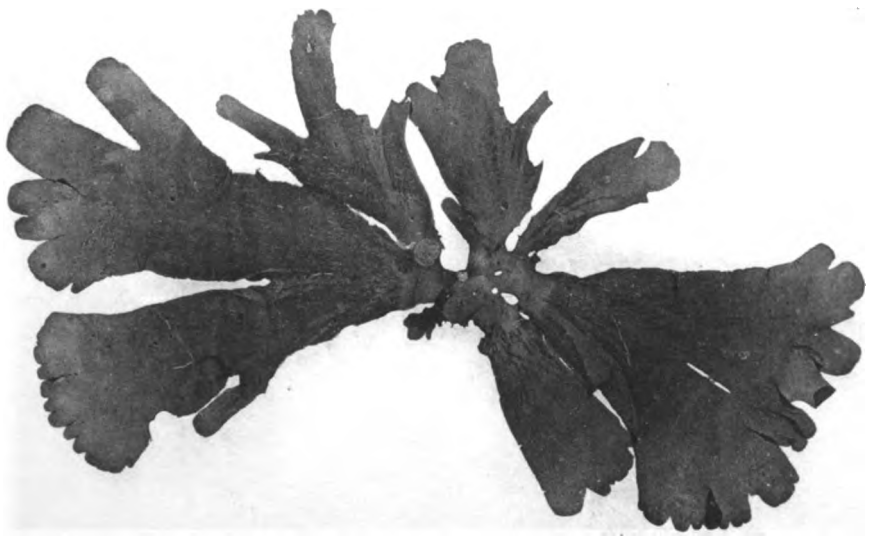

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Vol. 4, No. 18, pp. 317-374, pls. 36-53 Issued April 25, 1913

NEW FUCACEAE

BY
NATHANIEL LYON GARDNER

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NEW FUCACEAE

BY
NATHANIEL LYON GARDNER

In a previous paper of this series, "Variations in Nuclear Extrusions among the Fucaceae" (1910), in order to proceed intelligently it became necessary to give a brief systematic account of certain imperfectly understood forms of *Fucaceae* occurring on the coast of California. Since the appearance of that publication I have continued further the study of the group, with the result that several other new species have been discovered, two of which have been distributed in the Phycotheca Boreali-Americana of Collins, Holden and Setchell (no. CXV *b*, and nos. CXVI and CXVII, 1911).

In the present paper it has been thought advisable to give a more extended account of the new forms briefly described in the above mentioned paper, together with certain other new forms recently found on the coast of California, a few notes on some related species, and finally a new species of *Blossevillea*, from Guadalupe Island.

Hesperophycus Setchell et Gardner

Frons a disco radicali, elongata, costata, subpinnata, evesiculosa; receptaculis discretis, terminalibus, non aut lente inflatis; cryptostomatibus in lineis duabus in utroque latere costae; oogoniis oosphaeras duas maxime inaequales amplectentibus.

Genus in habitu Fuco valde simile sed in numero oosphaerarum in oogonio differens.

Hesperophycus Harveyanus (Dec'ne) Setchell et Gardner

Growing on rocks in the upper littoral zone, in California, reported from Monterey, Santa Barbara County, San Pedro, Laguna, San Diego and San Clemente Island. (Pls. 36 and 37, figs. 1, 2, and 3.)

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Tilden, Am., Alg., no. 339, 1900 (Exsic.). Not of J. G. Ag., Spets. Alg., p. 10, 1868, nor Spets. Alg. Till., p. 43, 1870. Not of Kjellman, Alg. Arct. Sea, p. 201.

De Toni, Syll. Alg., vol. III, p. 205 (in part).

From the above array of synonomy and citations of literature and exsiccatae, it will be seen that *Hesperophycus Harveyanus* has been studied and variously interpreted by a considerable number of algologists since its original discovery. So far as we have any knowledge, the discovery was made at Monterey, California, by some one on the frigate "La Venus," which sailed along the coast of California under the command of Captain Abel de Petit-Thouars during its voyage in 1836–39.

A full-sized drawing of a whole plant, and drawings more or less in detail of several of its parts, were published under the auspices of the Minister of Marine of France in 1846, but the description of the plant by Decaisne, who referred it to the genus *Fucus*, did not appear until 1864, when the botanical text of the voyage was published. Meanwhile, Harvey in 1851 mentions the same plant in the following language: "I forbear to describe this species, named and figured by my friend M. Decaisne, some years ago, but of which no specific character has, I believe, yet appeared. It is very closely related to *F.*

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ceranoides, and I am not certain by what characters it is proposed to be distinguished from that species."

Decaisne's description reads as follows: "F. fronde plana costata dichotoma integerrima evesiculosa foraminibus crebre inspersa, receptaculis ad apices ramulorum subpalmatim congestis parvis ovatis obtusis intus fibrillis farctis, conceptaculis sporas v. antheridia foventibus."

Decaisne's figure shows a distinct narrow midrib and has the cryptostomata promiscuously distributed over the whole frond. These are the characters that seem to throw doubt as to whether the plant here described is really the same as the one figured by Decaisne. Our plants are somewhat thicker in the center of the frond than at the margins, but do not show a distinct midrib even on drying. Again our plants characteristically have the cryptostomata arranged in a line near each margin, and have long exserted paraphyses, making them appear very conspicuous. This character is variable, however, in some plants the cryptostomata being somewhat profusely distributed. This is especially true of the plants found in the vicinity of Monterey.

Professor W. A. Setchell has examined the type specimen of Decaisne's species in the museum at Paris, and says that it very closely resembles Decaisne's figure. He also examined another specimen in Harvey's herbarium at Trinity College, Dublin, given to Harvey by Decaisne, collected at Monterey, which he says he thinks is exactly the same as our plant.

The writer has searched diligently in the vicinity of Monterey and along the coast to Carmel Bay, for other species of *Fucaceae* that might possibly be the plant described by Decaisne. The only other species found resembling *Hesperophycus* was a large species of *Fucus* with wide fronds and large receptacles. It is certain that this cannot be Decaisne's plant. Hence, there can be but little doubt that the plant here described is identical with Decaisne's plant.

Our California plant has certain superficial resemblances to the arctic plant, *Fucus ceranoides*. There are occasional short distichous branches which spread out, especially before fruiting, in a fan-like manner so characteristic of typical forms of *F. ceranoides*. Many of the receptacles are unbranched and are

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small and pointed, like those of some forms of *F. ceranoides,* which, however, seem to be very variable in this respect, as well as in other characters. Kjellman says in his *Remarks on the forms of this species,* referring to *F. ceranoides*: "Since I have seen the excellent and highly instructive series of forms of *Fucus ceranoides,* which Kleen has brought home from Nordlanden, and had the opportunity of comparing these forms with the two forms of *Fucus* found in the Arctic sea proper, *F. Harveyanus* and *F. divergens,* I cannot but adopt Kleen's opinion that these two must not be regarded as independent species, but are, in fact, forms of *F. ceranoides.*"

Kjellman is here following the opinion of J. G. Agardh, who had referred certain northern forms somewhat doubtfully to *F. Harveyanus,* not being thoroughly acquainted with Decaisne's plants of this name from Monterey. I have had the opportunity of examining several specimens in the herbarium of the University of California, under no. 132611, collected at Spitzbergen Island in 1861, and determined by J. G. Agardh as *F. Harveyanus* Dec'ne. These specimens all showed very distinctly the eight divisions in the oogonium, characteristic of the genus *Fucus.* This clearly removes all doubt as to the identity of the northern plant. It certainly is not to be confused in the future with the California plant, whose distinguishing generic character is the production of two oospheres unequal in size, only one of which is viable; and if the northern plant referred to *F. Harveyanus* is distinct from *F. ceranoides,* it must receive another specific name.

The California plant, under consideration here, is to be distinguished from the Arctic plant, *F. ceranoides,* as well as from all other species of *Fucus,* by its method of spore formation.

Pelvetiopsis Gardner

Frons a disco radicali, inferne cylindrica sed mox complanata, ecostata; receptaculis discretis, terminalibus, fere cylindricis, acuminatis; oogoniis duas oosphaeras maxime inaequales amplectentibus; cryptostomatibus sparsis in partibus juvenilibus; hermaphroditica.

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Pelvetiopsis limitata (Setchell) Gardner

Two fairly well defined forms of this species have been found in distinct localities along the California coast.

f. *typica* Gardner, fronde mediocri, 8–10 cm. longa, angusta. (Pls. 38 and 39, figs. 8–30.)

Pelvetia fastigiata f. *limitata* Setchell, *in* Collins, Holden and Setchell, Phyc. Bor.-Am., no. 1238, 1905 (Exsic.).

Pelvetia fastigiata Dec'ne. Tilden, Am. Alg., no. 233, 1898, and no. 517, 1902 (Exsic.).

f. *lata* Gardner, fronde longiore latioreque, 15–18 cm. longa, frequenter plus minusve contorta. (Pls. 40 and 41, figs. 31–43.)

in Collins, Holden and Setchell, Phyc. Bor.-Am., Fasc. E, no. CXIV, 1911 (Exsic.).

Gardner, Variations in Nuclear Extrusions among the Fucaceae, Univ. Calif. Publ. Bot., vol. 4, no. 6, p. 127, 1910.

f. *typica* has been collected at various localities along the Pacific Coast of North America from the west coast of Vancouver Island to Monterey, California.

f. *lata* is at present known to occur at three localities only, viz., at Point Cavallo, Marin County, California, between Moss Beach and Half Moon Bay, San Mateo County, California, and at Tomales Point, Marin County, California. At Point Cavallo it grows in a narrow zone in the very upper high tide limits, more or less shaded, and in quiet water. In the two latter localities it grows a little lower down in the littoral zone, exposed to the sun and to heavy surf.

Both forms may begin to fruit when quite young. Plants of f. *typica* have been found with receptacles longer than the remainder of the plant (*see* pl. 38, figs. 11 and 16).

The receptacles of f. *lata* are flat during the earlier part of the fruiting season, but later may become much swollen, thus resembling some forms of *Fucus* receptacles.

The principal reason for separating *Pelvetiopsis* from *Pelvetia* is the unequal division of the oosphere into two very unequal parts. This division always takes place at the base of the oogonium and is very frequently oblique instead of horizontal.

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If one relied wholly upon a single character in determining the generic position of a plant, *Pelvetiopsis* might be united with *Hesperophycus,* on account of the similarity in their respective methods of oosphere formation. If this policy were pursued, however, several other genera of the *Fucaceae* would have to be united, and eventually we might again arrive at a system of classification as wholly unnatural as that proposed by Linnaeus. The morphological characters, such as color, texture, absence of midrib, etc., of *Pelvetiopsis* seem to ally it more closely to *Pelvetia* than to *Hesperophycus,* and the morphological characters, such as color, abundance of cryptostomata, a midrib, etc., of *Hesperophycus* seem to ally that genus more closely to *Fucus* than to *Pelvetiopsis.* Taking all of these points into consideration, it has seemed to the writer to accord more nearly with a natural system of classification to keep these two genera, *Hesperophycus* and *Pelvetiopsis,* separate.

Since the publication of the two new genera, *Hesperophycus* and *Pelvetiopsis,* some slight criticism has been expressed as to the undesirability of multiplying genera in the *Fucaceae.* Dr. M. A. Howe (1911) in a review of my paper, "Variations in Nuclear Extrusion among the *Fucaceae,*" in which the above-mentioned genera were described, states the following: "These results suggest to the reviewer the possibility that similar accurate investigations of the number and character of the oospheres of the remaining *Fucaceae* of the world, might lead to the discovery of grounds for several other similar generic segregations, and that a large number of genera thus based might prove rather impracticable and unnatural."

In justification of the establishment of the above-mentioned genera, it might be stated that the results of the investigations necessitated following one of at least two courses: it was necessary either to extend and split up the well established genus *Fucus* in such a way as to include this newly discovered method of fruiting, disregarding as a generic fundamental the production of eight oospheres in an oogonium, or to create new genera. The author could apprehend no grave danger in pursuing the latter course. If the former policy had been pursued, there

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would have been no good reason for not having absorbed into the same genus the genus *Pelvetia,* for there are no distinctive gross morphological characters by which it can be distinguished from the genus *Fucus,* and it is only when one examines into the fruiting characters with a microscope that one is able to distinguish these two genera, at least, in some of their forms. While it is true that among the *Fucaceae* many of the genera have distinguishing morphological characters associated with distinguishing fruiting characters, it is by no means safe to rely wholly upon the former for generic distinction.

Halidrys dioica Gardner ms.

Stipite perrenni e basi solida et verrucosa oriundo, tereti, ad nodos geniculato 40–50 cm. longo, 4–6 mm. in diam., solido, flexibili, non, furcato; ramis primariis (aut pinnis) annuis in stipite alterne et subdistiche positis, sub apice crescendo oriundis, 10–18 dm. longis, basi complanatis linearibusque, superne pinnate ramulosis, ad 10–25 cm. longis et 8–12 mm. latis; ramis secundariis (aut pinnulis) sessilibus, complanatis, apicibus acutis aut obtusis, inferne integris, superne varie lobatis incisisque usque pinnatifidis; vesiculis siliquaeformibus alatis, 5–9 septatis, ad nodos lente constrictis, marginibus integris, apicibus mucronatis, basibus rotundatis; receptaculis filiformibus ramosis ad apices ramulorum ultimorum aut vesicularum; conceptaculis numerosis, mammiformibus sine ordine definito dispositis. Frondibus perennibus, diocis, masculis et femineis conformibus.

Stipe arising from a flattened solid, warted base, terete, bent at the "nodes," 40–50 cm. long, 4–6 mm. in diameter, solid, flexible, not forked; primary pinnae annual, arranged alternately upon the stipe, always arising just below the growing point, 10–18 dm. long, flat and linear at the base, pinnately branched above, the linear portion 10–25 cm. long, 8-12 mm. wide; secondary branches or pinnules sessile, flat, acute or obtuse at the apex, the oldest ones entire, the younger ones variously notched and incised, the incisions increasing in depth, and the segments increasing in length toward the apex of the branch, the uppermost becoming pinnately branched; the upper secondary branches develop flattened, margined, lanceolate, acuminate, short pediceled air vesicles, divided into 5–9 chambers, slightly constricted at the divisions, the oldest ones rounded at the base

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and mucronate at the apex; the apex of the younger ones develops farther into branched filiform receptacles which in turn bear many mammiform conceptacles; plants perennial, dioecious, the two sexes being indistinguishable by external morphological characters; color varying from dark brown to olive green; in the littoral zone on exposed rocks, or in the sublittoral zone in quiet water, at San Pedro, Redondo, and at Avalon on Santa Catalina Island, California. (Pls. 42–45, figs. 44, 45, 46, and 47.)

Gardner ms. *in* Collins, Holden and Setchell, Phyc. Bor.-Am., Fasc. E, nos. CXVI–CXVII, 1911 (Exsic.).

Guernsey, Notes on the Marine Algae of Laguna Beach, p. 206, First Ann. Rep. of the Laguna Marine Lab., Pomona College, Claremont, Calif., May, 1912.

Halidrys dioica is often cast ashore in abundance with *Cystoseira Osmundacea* and *C. Setchellii*, and because of its superficial resemblance to these species has doubtless been confused with them and hence has been overlooked by collectors. It is the only known *Halidrys* in the Pacific Ocean. It differs from *H. siliquosa* of the Atlantic Ocean in having smaller, wider winged, more lanceolate, shorter stiped air vesicles; in the more profusely branched fruiting ramuli which frequently arise from the side of the air vesicles; in the more "zigzag" character of the stipe and lower branches; and by being dioecious.

Like our Pacific Coast species of *Cystoseira*, *H. dioica* continues to grow until it is broken from its mooring and cast ashore, the primary branches being deciduous and the growing point inconspicuous. On rocks exposed to the surf, the fruiting branches are quite effectually worn away in the autumn, and in the winter the young flattened primary branches, being 10–15 cm. long before they begin to branch, present a quite different appearance from the mature fruiting plants of the summer. Many young plants produce fruit in abundance without producing air vesicles.

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Blossevillea Brandegeei Setchell et Gardner sp. nov.

Frondibus erectis e surculis prostratis curtisque orundis, irregulariter ramosis, ad saxa per hapteres discoideas adhaerentibus inferne cylindricis aut subcylindricis superne complanatis et costatis nonnumquam furcatis, 25–35 cm. altis, 4–6 mm. latis, alterne pinnatifidis et geniculatis; pinnis e marginibus solummodo oriundis, lente costatis, 2–3 pinnatifidis, 5–8 cm. longis; receptaculis ramulos ultimos terminantibus, 10–15 mm. longis; conceptaculis mammiformibus utroque latere lente complanatorum receptaculorum longitudinaliter et distincte biseriatis; vesiculis nullis; monoicis; oospheris in oogoniis singulis; frondibus siccis atris et maxime fragilibus.

Erect fronds developing from short, irregularly branched, prostrate filaments attached to rocks by small disk-like holdfasts; fronds cylindrical or subcylindrical at the base, gradually becoming flattened, with a midrib, occasionally forked, 23–35 cm. high, 4–6 mm. wide, alternately pinnatifid, producing a geniculate appearance throughout the whole plant; pinnae arising from the margins only, slightly midribbed, twice or thrice pinnatifid, 5–8 cm. long; receptacles terminating the ultimate ramuli, 10–15 mm. long; conceptacles mammiform, usually in two fairly well defined rows on each side of the slightly flattened receptacles; air vesicles absent; dried plants black and very brittle; monoecious; one oosphere in each oogonium. (Pl. 46, figs. 48, 49, and 50.)

Type specimens in the herbarium of the University of California; no. 163378 collected by T. S. Brandegee on Guadalupe Island off the coast of Lower California in 1897; and no. 163380, a fruiting bit of a plant from the herbarium of Professor W. G. Farlow of Harvard University, collected on the same island by Dr. Edward Palmer.

When I began the study of *Blossevillea Brandegeei*, the dried specimens at hand from Guadalupe Island suggested to my mind in a vague general way a resemblance to some of the species of *Cystophora* J. Ag. in the herbarium of the University of California. Happily the material proved to be in good fruiting condition and upon microscopic examination it was ascertained that but a single oosphere developes in each oogonium, a

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characteristic of the genus *Cystophora*, or *Blossevillea*, as stated by Oltmanns. However, the absence of air vesicles seemed to be a fatal objection to placing the plant in that genus. The other morphological characters, and the reproductive characters, seemed, however, certainly to ally it more closely to *Cystophora* than to any of the other related genera. A search in the literature, and a study of herbarium material, were made to learn if any other plants without vesicles had been assigned to the genus *Cystophora*.

In 1895 De Toni assembled and described twenty-four species of *Fucaceae* in his "Sylloge Algarum" under the genus *Cystophora*. One species (*C. Lenormandiana* from Hong Kong, China) was placed here with doubt and A. and E. S. Gepp have since shown that *C. elongata* of De Toni's list is identical with *Carpophyllum angustifolium*, becoming according to the Vienna rules, *Carpophyllum elongatum*.

Since 1895 but two other species have been added to *Cystophora*, *C. cuspidata* J. Ag. (1896) and *C. elongata* J. Ag. (1897). This makes a total of twenty-four fairly well defined species belonging to this genus, some of which date back to Dawson Turner (1811). J. Agardh proposed the name *Cystophora*, "vesicle bearer," in 1841, and in 1848, in "Species Algarum," he assembled nineteen species under the genus. Fifteen of these were retained by De Toni. Among Agardh's species five had been published by Turner under "*Fucus*," and one of these, *C. paniculata*, first collected by Mr. Brown at Kent's Island, off the coast of Australia, has no air vesicles. It thus appears that Agardh himself included forms without vesicles. In some other species of the genus the vesicles are either absent, unknown, or rare, while in others they are very abundant. This condition of variability also holds good among the species of *Cystoseira* Ag.

Taking the above facts into consideration, it seems best for the present, at least, to place our plant of the northern region with those of the southern hemisphere—that is, with that group of *Fucaceae* which has been variously designated by different authors at different times under *Cystoseira*, *Blossevillea*, *Cystophora*, etc.

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It is not my purpose in this paper to attempt to define the limits of these various genera, but the matter of the selection of a generic name for our plant seems to lie between *Blossevillea* and *Cystophora,* as these two names seem to be held to be synonymous by the majority of the algologists. *Blossevillea* was established by Decaisne in 1840 and *Cystophora* by J. G. Agardh in 1841. Neither of these authors, however, in making his diagnosis mentioned any particular species either for their type, or as included in the genera proposed. In each case it seemed to be intended to separate these southern forms from the European forms, all of which had previously been included by C. A. Agardh under *Cystoseira.* I quote below the characterization of these genera by each of these authors, neither of which alone is sufficient to distinguish it from nearly related genera.

"Je divise le genre *Cystoseira,* en prenant pour base de ces divisions la disposition des réceptacles portés sur des ramifications des frondes ou plongés dans les frondes elles mêmes; je donne le nom de *Blosvillea* a toutes les especes de l'Océan austral; elles sont caractérisées par la courbure et le mode d'insertion des rameaux sur la face plane de la tige principale, et par la structure des réceptacles, dans lesquels les conceptacles forment deux séries parallèles, tandis que dans les vrais *Cystoseira,* ces conceptacles sont placés sans ordre apparent."—J. Decaisne, 1840.

"Hoc autem genus in duo tunc quoque dilabitur. 1. *Cystophora* vesiculis subsphaericis in pedicello solitariis et ramis retroflexis insigne, species Australasiae continens; 2. *Cystoseira* vesiculis plus minus ellipticis in ramo inflato moniliformiter concatenatis, concatenatio, et apotheciorum ortu ex inflatis spinarum confluentium basibus distinguendum, species praecique Europeas continens."—J. G. Agardh, 1841.

In 1842 Decaisne first published a list of five species of *Blossevillea,* all of which are retained by De Toni under *Cystophora,* but Agardh did not publish his list of species of *Cystophora* until 1848. Since Decaisne's diagnosis of the genus appeared before that of Agardh, and since the publication of Decaisne's list of species of *Blossevillea* antedates the publica-

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tion of Agardh's list of *Cystophora,* we have been compelled to adopt *Blossevillea* for the name of our plant, rejecting the original spelling *Blosvillea* as evidently a "typographic error."

All of the other species of *Blossevillea,* except *B. Brownii,* are inhabitants of the region of Australia and New Zealand. *B. Brownii* was first collected by D'Urville on the coast of Chili during the voyage of "La Coquille," 1822–25, and determined by Bory de St. Vincent. *B. Brandegeei* is now the only known member of this genus of the southern waters in the north temperate zone. How to account for its presence so far away from the other members of the genus, thus becomes a matter of no little interest and importance in geographical distribution.

It may be desirable to explain why the Guadalupe plant is not referred to the genus *Bifurcaria* Stack., since it has a creeping rhizome-like base and "bilateral," rather than "radial," branching (cf. Gruber, 1896, p. 29, etc.), but the possession of the first mentioned structure can hardly be considered to be a basis for generic character, and while the genus *Cystophora* J. Ag. is ranged with the radial *Cystoseirae* (Gruber, 1896, p. 30), it is admitted that certain species of the genus are "bilateral" (cf. Gruber, *loc. cit.*). The strongly monopodial and pinnate character of the branching, the zigzag axis, and the apparently deciduous pinnae of the Guadalupe plant seem to indicate a much closer relationship to *Cystophora* J. Ag., i.e., *Blossevillea* Dec'ne, than to *Bifurcaria* Stackh.

Guadalupe Island is situated in latitude 29 degrees north. and is a little over a hundred miles off the coast of Lower California. It lies within the eastern part of the great Japanese current flowing from the north, and the prevailing winds are northerly. We should expect that these agencies might have had in the past a profound influence in determining the kinds of plants that now inhabit the island. Of the character and quantity of the marine flora we know practically nothing, but a systematic study of the land flora has indeed shown that the majority of the plants found there are not like those of the adjacent coast of Lower California and Mexico in the same latitude, but like those of California south of San Francisco, and ranging eastward. About forty per cent of the land flora

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is said to be the same as that of California, which indicates a probable southern migration, doubtless due to the above-mentioned agencies. Several species, notably the wild oats and filaree, plants introduced into California, have recently gained foothold on the island.

The most interesting feature in this connection, however, is the fact that of about one hundred and thirty species of land plants, about thirty are at present known to be endemic. This indicates that at least the land flora is of ancient origin.

Cystoseira Setchellii sp. nov.

Stipite perenne e basi irregulariter conica solidaque oriundo, flexibili, cartilagineo irregulariter et sparse furcato, 2–3 dm. longo, 8–10 mm. in diam., triangulari in sectione transversali, ramos numerosos, alternos, complanatos, approximatos sub apice crescendo emittente; ramis complanatis annuis, deciduis, cicatrices conspicuas defoliatione facientibus basi serratis, medio pinnate lobatis aut pinnatifidis, apice pinnate in ramulis filiformibus dissectis, ramulis serratis, lobatis, et dissectis; vesiculis, 1–3 seriatis, sphericis, 6–8 mm. in diam., ad bases ramorum ramulorumque lateraliter positis, apicalibus mucronatis; receptaculis ramulos terminantibus, 15–25 mm. longis. Planta tota 6–8 dm. longa, fusca, siccitate atra; dioica, mascula et feminea conforma.

Stipe developing from an irregularly conical-shaped solid base, flexible, cartilaginous, irregularly and sparingly forked, 2–3 dm. long, 8–10 mm. in diameter, triangular in cross section, giving rise to numerous alternate flattened branches at short intervals, always from just below the growing point; flattened branches coriaceous, annual, deciduous, thus producing prominent scars on the stipe, serrated at the base, deeply and pinnately lobed or divided in the middle, 3–4 times pinnately divided into filiform ramuli at the apex; the pinnate segments may in turn become serrated, lobed and divided; receptacles terminal on the ramuli, 15–25 mm. long; air vesicles 1–3 seriate, terminal one frequently mucronate, spherical, containing internal, longitudinal white fibers, without a margin, 6–8 mm. in diameter, situated at the base of the serrated segments, or at the base of the filiform branches; whole plant 6–8 dm. long; the color of the living plant

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dark brown, turning black when dry; perennial; dioecious, the two sexes being very similar in external appearance; in the sublittoral zone at San Pedro and Redondo, California. (Pl. 38, figs. 4, 5, 6, and 7, and pls. 47–50, figs. 51, 52, 53, and 54.) It has been distributed in Collins, Holden and Setchell, Phyc. Bor.-Am., Fasc. E, no. CXV *b*, 1911, as an antheridial plant of *C. Osmundacea*.

In 1908 when I began to collect and study the forms of *Cystoseira* growing at San Pedro, California, I discovered a number of short, but otherwise well developed plants belonging to the above genus, and upon microscopic examination of a considerable number of specimens, it proved by chance that all of them were antheridial. I then examined a number of the long fruiting specimens of the genus which were abundant in that locality, and singularly enough they proved to be oogonial plants. Consequently, I concluded that there existed a sort of dimorphism in this species which had hitherto been overlooked, and proceeded without further critical examination to collect the two forms for distribution under *Cystoseira Osmundacea* in the above-mentioned work. Later I found oogonial plants among the short forms, which led to the discovery of antheridial specimens among the long forms. Corresponding morphological differences, such as a difference in the number of air vesicles, proved by more study to be constant in each form; hence, I have concluded after careful study that the long plants and the short ones belong to two distinct species, one of which is new to science, and this I propose to dedicate to Professor William Albert Setchell, who has always given to me so unsparingly his time, and has been so helpful to me in my research on the Pacific Coast algae.

I have not yet discovered any superficial characters by which the two sexes of these two species may be determined. The main stipe arises from a solid disk-like base or "holdfast" which later becomes conical in general appearance, but more or less irregular in outline, and of a fibrous consistency. The main stipe gives rise to other stipes, which seem to arise by a division taking place at the growing point. This matter has never been

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definitely settled, but the evidence for the conclusion expressed here is that there is no noticeable difference in size at the junction of any two divisions, and all of these branches are the same in size throughout their entire length below the secondary branches. They are 8–10 mm. in diameter, and vary in length with age; triangular in cross section with sharp angles; and give rise to numerous flatened branches at frequent intervals, thus producing very short "internodes."

These flattened leaflike branches are alternate upon the stipe and are deciduous, leaving prominent conspicuous scars on the stipe, which becomes slightly bent at those points. The flattened branches grow to be 30–40 cm. in length, and 3–5 cm. wide. Considerable variation exists among the succeeding divisions of these branches. On very young plants, and the young branches on older plants, they are deeply serrated with alternate distichous divisions. On young plants, and occasionally on older ones, a few of these divisions near the apex are metamorphosed directly into filiform ramuli, with but few air vesicles at their base, and become the receptacles and bear the fruit. (See pl. 38, fig. 4.) On other and older plants, the incisions may extend deeper and the segments become much longer and rounded at the outer end, some toward the apex even becoming 15–18 cm. long, and they in turn becoming alternately and distichously serrated, while at their ends the filiform ramuli bearing receptacles and fruit appear. (See pl. 48, fig. 52.)

More frequently, however, these latter serrated divisions do not appear, but the segments metamorphose directly into quite long—8–12 cm.—variously branched fruiting ramuli.

Thus, in a case of extreme branching of the plant we may have the main triangular stipe (*a*) which may branch to form other triangular stipes, (*b*) these in turn give rise to flattened branches, (*c*) whose segments (*d*) may in part bear similar segments (*e*) which may be variously divided into filiform fruiting segments, (*f*), (*g*), etc. The oldest plants are rarely over 75 cm. long.

On a medium-sized plant there are usually from three to five branches (*c*), on each branch (*b*), bearing fruit in a single season, while several smaller branches are maturing near the growing

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point preparatory for the next year's fruiting. The first season's growth of branches (*c*) seems to arise directly from the "holdfasts," but careful observation will reveal a short terminal, though seemingly lateral, growing point. The growing point is rather inconspicuous even in a mature plant.

The air vesicles are short, consisting of one, two, or three moniliform divisions, which are 6–8 mm. in diameter, and which are formed by deep constrictions. The terminal one is usually mucronate. They are developed at the base of the flattened branches, (*d*), taking the place of one, two, or three segments, or they may be located farther up at the base of the fruiting ramuli. (See pl. 38, figs. 4–7.) The receptacles are terminal, 15–25 mm. long, bearing numerous conspicuous conceptacles, disposed in no definite order. The fruiting ramuli of a well-developed plant are quite dense, and on this account in a superficial way resemble a cluster of grapes in outline. (See pl. 49, fig. 53.)

Cystoseira Setchelli may be easily confused with *C. Osmundacea* f. *expansa,* especially with the young and with the dwarfed specimens of the latter growing in tide pools, as is frequently the case. *C. Setchellii* seems to be exclusively a deep water plant. I have seen hundreds of specimens which have been cast ashore, but have never seen any growing in position, while *C. Osmundacea* f. *expansa* is a plant of the rock pools and the upper sublittoral zone. The color of the two plants is practically the same, yellowish brown.

C. Setchellii is to be distinguished from *C. Osmundacea* f. *expansa* by the more serrated character of the (*c*) branches of the young fronds, the larger size and fewer in number of air vesicles, being from 1–3 chambered in a moniliform series in *C. Setchellii,* and from 8, even up to 20, chambered moniliform series in *C. Osmundacea* f. *expansa.* They are particularly to be distinguished by the length of the fruiting portions, which in *C. Setchellii* are only from fifteen to twenty centimeters long, while in *C. Osmundacea* they average from three to three and a half meters long, and I have measured some plants of f. *expansa* growing at San Pedro, California, in comparatively quiet water, that were five meters long.

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Nothing is definitely known as to the age of these plants, but judging from the scars formed by the deciduous branches on the longest stipes, some of them must attain the age of fifteen years before being torn loose and cast ashore.

Cystoseira Osmundacea (Menz.) Ag.

(Pls. 51 and 52, figs. 55 and 56.)

Sp. Alg., vol. I, p. 69, 1821; Syst. Alg., p. 287, 1824.
De Toni, Syll, Alg., vol. III, p. 174, 1895.
McClatchie, Proc. So. Calif. Acad., vol. 1, p. 353, 1897.
Collins, Holden and Setchell, Phyc. Bor.-Am., no. XCVI, 1905, and CXV *a*, 1911 (Exsic.).

Halidrys Osmundacea Harvey.
in Hooker and Arnott, Bot. Beechey's Voyage, p. 407, 1841; Ner. Bor.-Am., part I, p. 64, pl. II, 1851.
Kützing, Phyc. Gen., p. 359, 1843; Sp., p. 604, 1849; Tab. Phyc., X, p. 23, Tab. 62, f. II, 1860.
Agardh, J. G., Sp. Alg., p. 237, 1848.
Farlow, Proc. Am. Acad., vol. 10, p. 353, 1875; Report of U. S. Fish Com. for 1875, p. 206, 1876.
Farlow, Anderson and Easton, Alg. Am.-Bor., no. 106, 1879 (Exsic.).
Anderson, Zoe, vol. II, p. 221, 1891.
Howe, Erythea, vol. 1, pp. 65, 67, 1893.

Stephanocystis Osmundacea Trevisan.
in Endlicher, Gen. Plan., suppl. III, p. 31, 1843.
Ruprecht, Neue Pflanzen, p. 12 (68), pl. III, 1852.

Fucus Osmundaceus Menzies.
in Turner, Fuci, vol. II, p. 92, pl. 105, 1809.

Cystoseira Osmundacea f. *expansa* (Ag.) Setchell.
Collins, Holden and Setchell, Phyc. Bor.-Am., no. XLVIII, 1901 (Exsic.).

Cystoseira expansa Ag.
Syst. Alg., p. 290, 1824.
J. G. Ag., Sp. Alg., vol. I, p. 226, 1848.
Harvey, Ner. Bor.-Am., part I, p. 66, pl. I *b*, 1851.

Cystoseira Douglassi Harvey.
in Bot. Beechey's Voyage, p. 407, 1841.

Sirophysalis expansa Kütz.
Sp. Alg., p. 603, 1849.

So far as we have any authentic recorded knowledge of this interesting member of the *Fucaceae,* Archibald Menzies first brought it to the attention of the European algologists. He is reported to have discovered and collected it at Port Trinidad,

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Humboldt County, California, in 1793. From some of the early descriptions which we have of it, it would seem that he collected only fragments and these mostly young.

We are indebted to Dawson Turner for the first published account of it, which appeared in his *Fuci* in 1809. Turner laments the fact that he had what seemed to him to be only a fragment of the plant in an immature stage of growth. But at the same time he felt confident that from the very marked characters of the portions that he had at hand, this plant was unlike any described species. His drawing faithfully represents what we now know to be a fairly well developed branch of a plant. showing the flattened pinnate portion, merging into moniliform vesicles and finally into the variously branched upper portions which later become much extended and develop the receptacles. On account of the pinnate nature of the flattened portion, which resembles the leaves of species of the genus *Osmunda,* Menzies suggested to Turner that *Osmundaceus* be adopted as the specific name. Following the accepted idea of the time, that all the large brown seaweeds, etc., should be placed under the genus "*Fucus,*" Turner first published the name for our plant as *Fucus Osmundaceus.* Since Turner has given to us our first published account, it would seem more fitting to ascribe the authorship to him than to Menzies and this has sometimes been done.

In 1821 C. A. Agardh established the genus *Cystoseira* and grouped under it a large number of vesicle-bearing *Fucaceae,* including *Fucus Osmundaceus* Turn. In 1824 he also published *Cystoseira expansa,* based upon material found "in mari australi." It is not definitely known upon what material this species was founded, for no subsequent authors have referred to it from the southern locality. Possibly he may have had access to material collected by Menzies in 1793, and incorrectly labeled. At the time of Agardh's publication Douglas and Coulter had not yet visited our coast.

Harvey published an account in 1841 of material collected by Douglas in 1830 at Monterey, as *Cystoseira Douglasii.* J. G. Agardh, in 1848 (p. 226) placed *C. Douglasii* Harv. as a synonymy under *C. expansa,* but states further "Hab. in mari

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Pacifico ad oras Californiae (Douglas!)." This indicates that J. A. Agardh must have felt certain that the material upon which *C. expansa* was founded is identical with material collected by Douglas at Monterey.

A careful study of herbarium material collected at various well-known localities along the California coast from Mendocino County to San Diego; and more particularly, a study of living material growing in position and cast ashore, has led to the conclusion that all of the above references really concern but one and the same species, which is subject to considerable variation due to differences in habitat and locality.

The type locality of *C. Osmundacea* is Port Trinidad, California, and the only reference we have of its occurrence farther north is one by L. M. Turner, who has placed a plant under *Halidrys Osmundaceus,* doubtless referring to the above plant, from Sannak Island, Alaska. It is quite possible that the plant referred to may be *Cystophyllum geminatum* (Ag.) J. Ag., which is common in the Northern Pacific region. The present definitely known southern limit of *C. Osmundacea,* on the other hand, is San Diego, California.

I have grouped the literature and the plants in exsiccatae, as best I can with the present data, into two groups. One group under *C. Osmundacea* includes references to the typical forms growing in situations exposed to heavy surf, and in the northern part of the range. Such plants agree thoroughly with the description and plate of Turner (*loc. cit.*) and are usually shorter but much more robust in all of their morphological characters than those referred to under the second group, viz., *C. Osmundacea* f. *expansa.* These two groups simply represent the extremes of a species, between which there are all possible gradations in every morphological feature. It is proposed here to distinguish these two groups in a general way as follows:

C. Osmundacea (Menz.) Ag. f. **typica** comb. nov.

Fucus Osmundaceus Menzies *in* Turner, Fuci, vol. II, p. 92, pl. 105, 1809.

Plants growing in localities exposed to the surf; fruiting portions comparatively short, less branched and more robust, air vesicles large, not very numerous, flattened fronds, robust and simply pinnate. (Pls. 51 and 52, figs. 55 and 56.)

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C. Osmundacea f. expansa (Ag.) Setchell

Plants growing in sheltered places, fruiting portions very long, paniculately much branched, attenuated; air vesicles small, numerous; flattened fronds often twice or thrice pinnatifid.

The average length of the mature fruiting plants belonging to the first group is from 2 to 3 m., and of those of the second group from 3 to 6 m. (Pl. 53, fig. 57.)

Occasionally fragments of the upper portion of plants have been found cast ashore in southern California, which possibly may represent still another distinct species. They somewhat resemble the fruiting portions of f. *expansa* of the above; but the character of the vesicles more nearly represents those of a *Cystophyllum*. It will not be possible to place such forms with certainty until the whole plant can be found and more critical study put upon it.

In conclusion I wish to express my sincere appreciation for the generous assistance rendered by Professor W. A. Setchell in the preparation of this paper.

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EXPLANATION OF PLATES

Plates 36, 42, 43, 44, 45, 47, 48, 49, 50, and 53 were photographed by Chas. A. Bowser; and plates 37, 38, 39, 40, 41, 46, 51, and 52 were photographed by M. B. Nichols.

PLATE 36

Hesperophycus Harveyanus (Dec'ne.) Setchell et Gardner

Fig. 1.—A young plant showing the exserted paraphyses from cryptostomata along the margins of the fronds.

Fig. 2.—A mature plant representing the fruiting receptacles. Photographed from fresh material collected at San Pedro, California, in September. One-eighth natural size.

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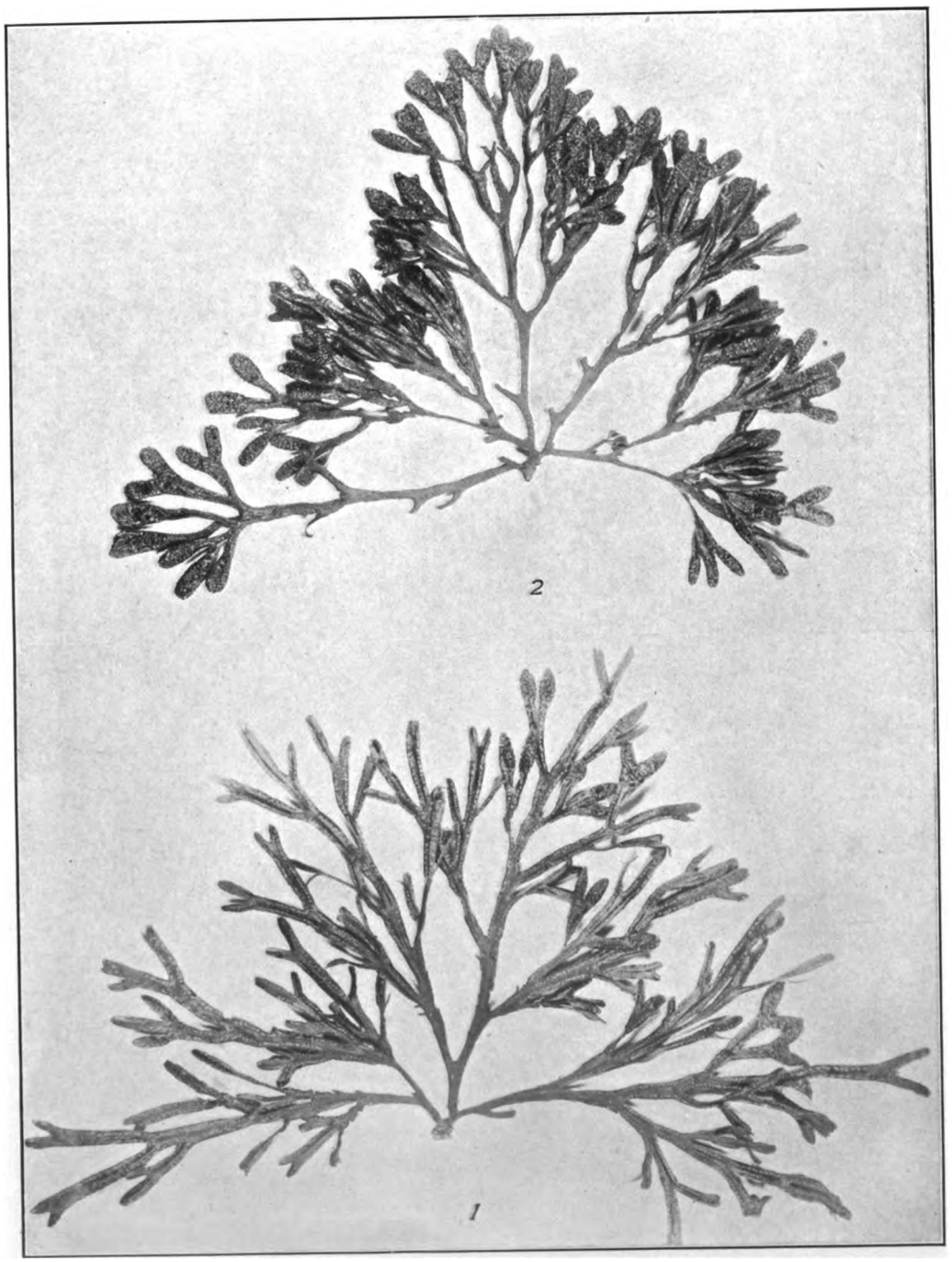

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PLATE 37

Hesperophycus Harveyanus (Dec'ne.) Setchell et Gardner.

Fig. 3.—Photographed from dry specimen collected at Monterey. One-eighth natural size.

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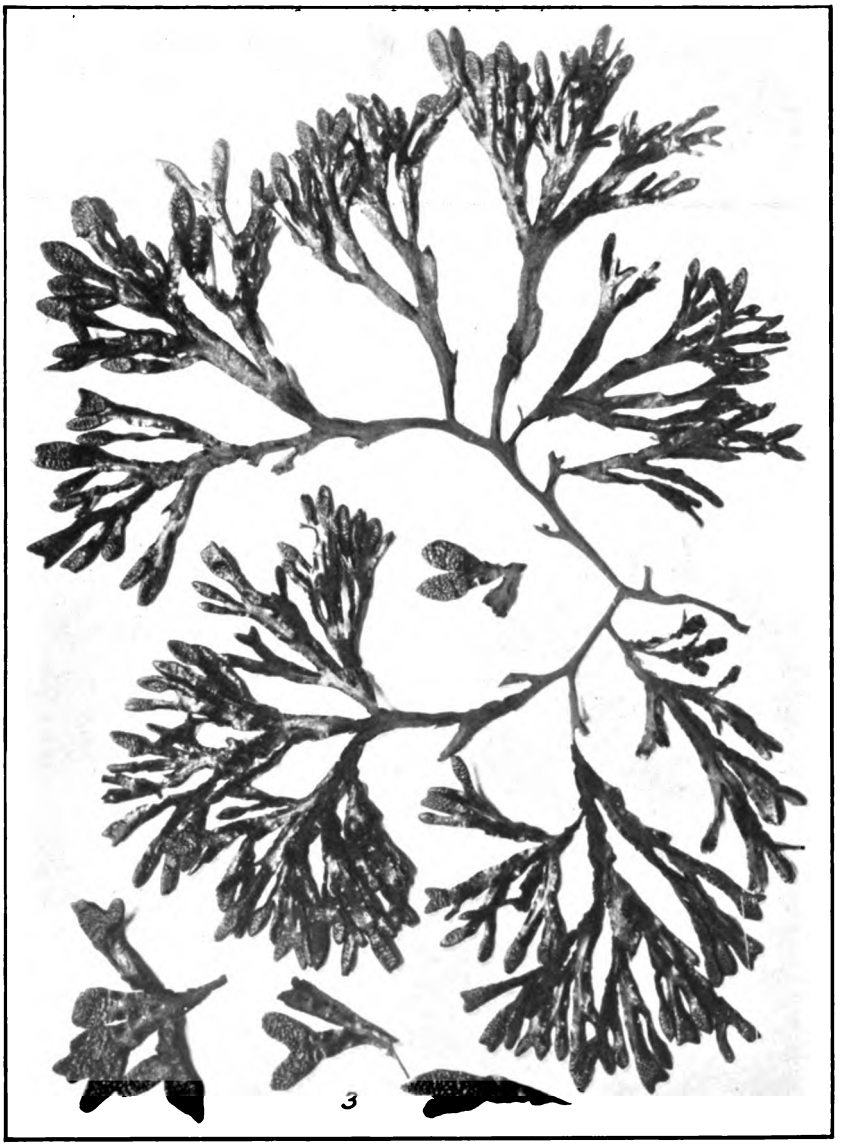

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PLATE 38

Cystoseira Setchellii sp. nov.

Figs. 4–7.—Portions of the flattened frond showing the position of vesicles and the number in a series. One-third natural size.

Pelvetiopsis limitata f. typica Gardner.

Figs. 8–16.—Various ages and forms. One-quarter natural size.

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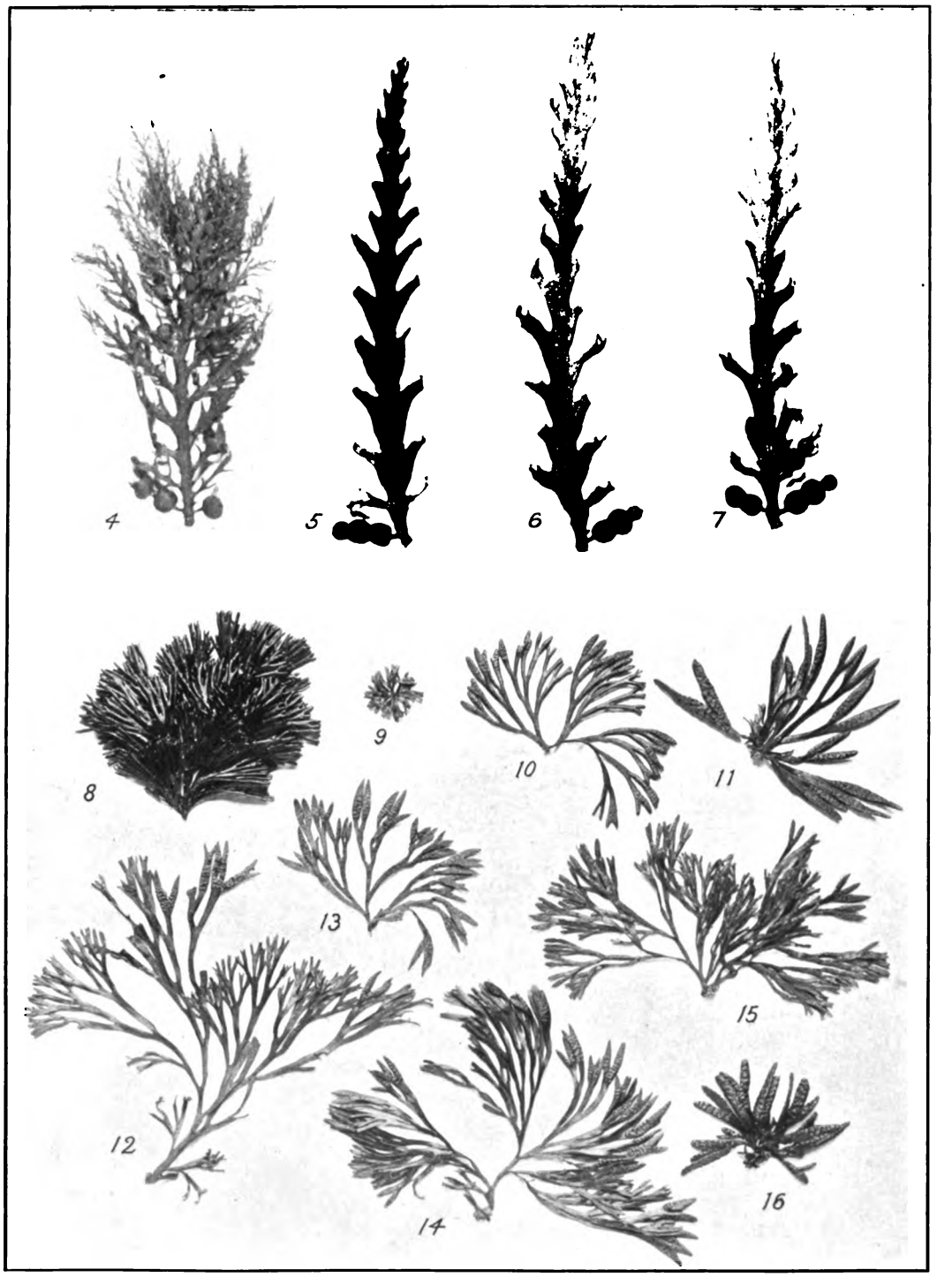

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PLATE 39

Pelvetiopsis limitata f. typica Gardner.

Figs. 17–30.—Showing various forms of receptacles slightly reduced.

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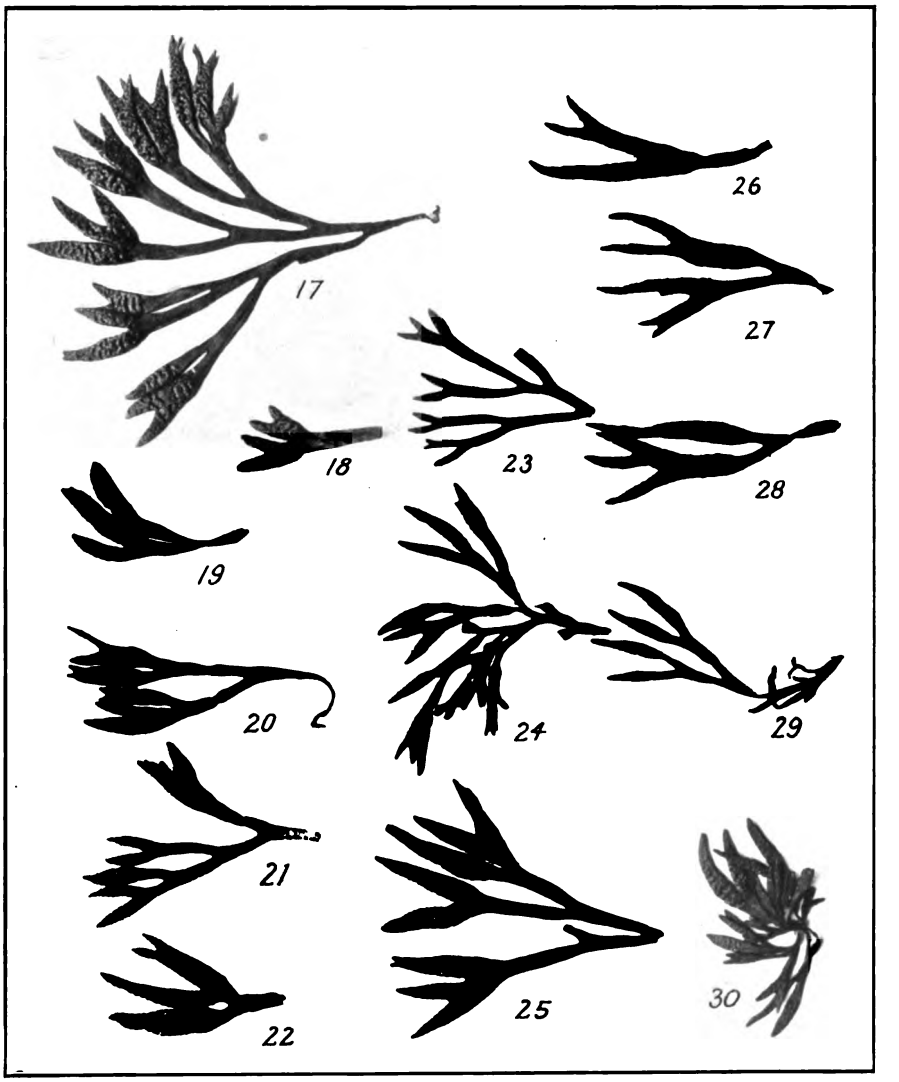

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PLATE 40

Pelvetiopsis limitata f. *lata* Gardner.

Figs. 31–33.—Fruiting plants. Photographed from living material. One-quarter natural size.

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PLATE 41

Pelvetiopsis limitata f. *lata* Gardner.

Figs. 34–43.—Showing various forms of receptacles, natural size. Photographed from living material.

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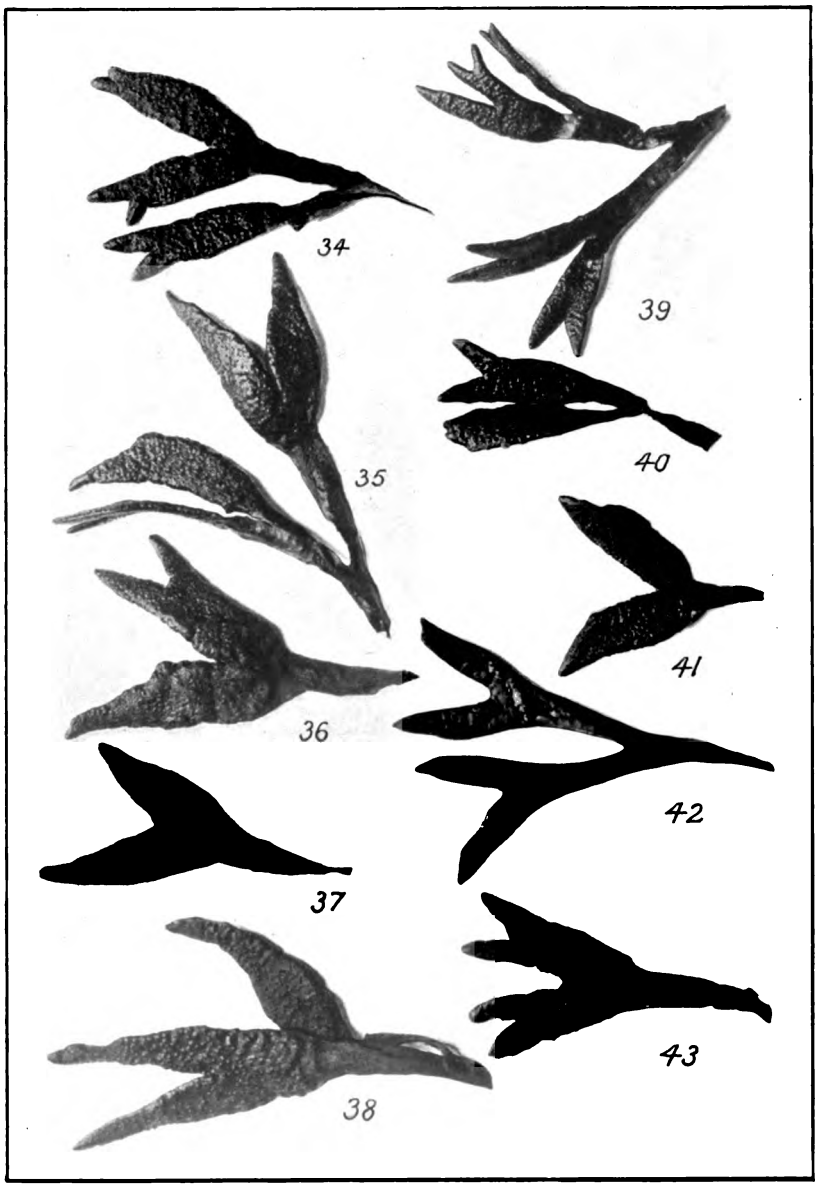

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PLATE 42

Halidrys dioica Gardner.

Fig. 44.—Showing all of the different parts of a well developed robust plant. One-twentieth natural size.

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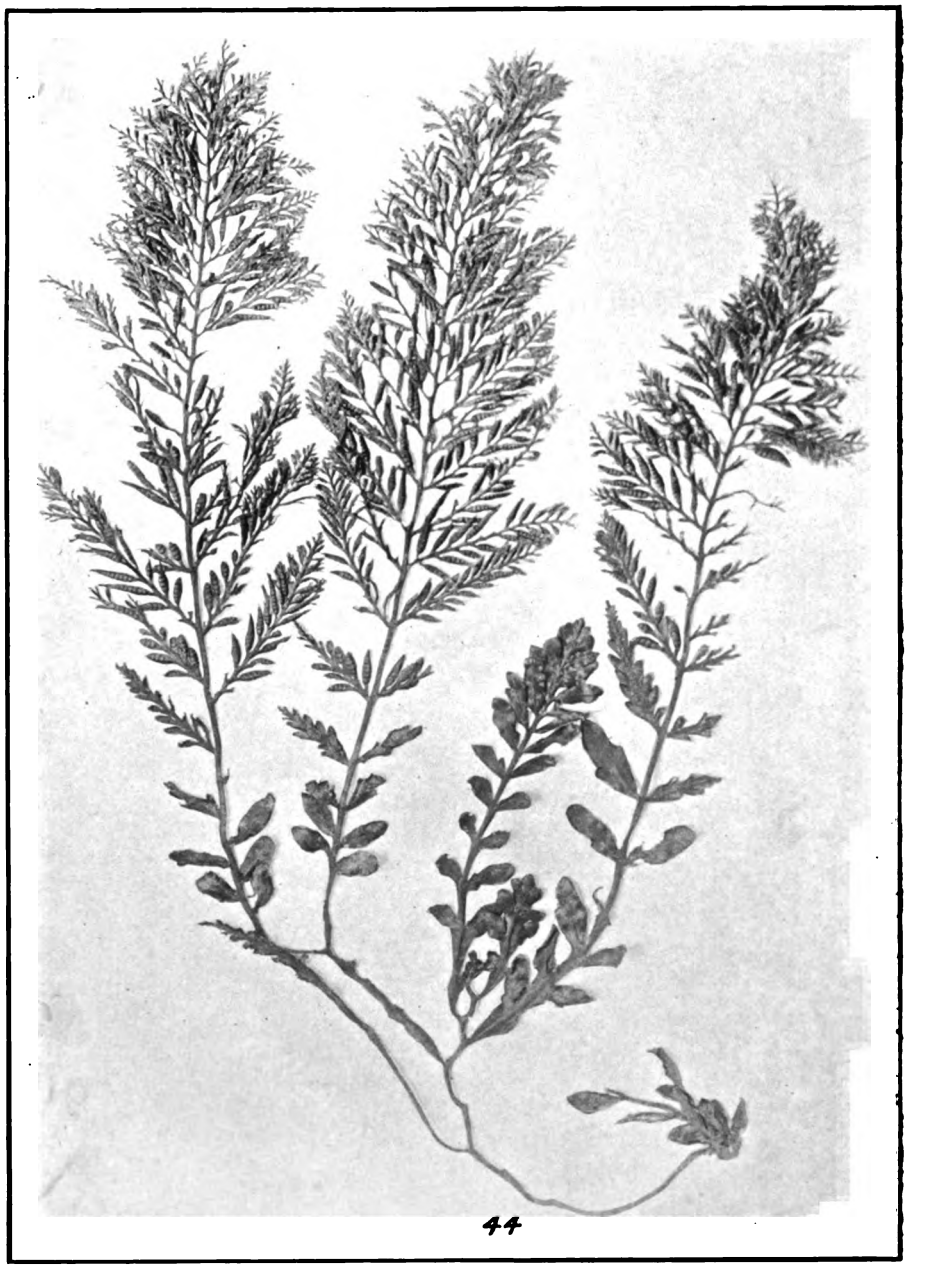

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PLATE 43

Halidrys dioica Gardner.

Fig. 45.—Showing the character of the stipe, holdfast, and primary branches with fruiting parts cut off. Much reduced.

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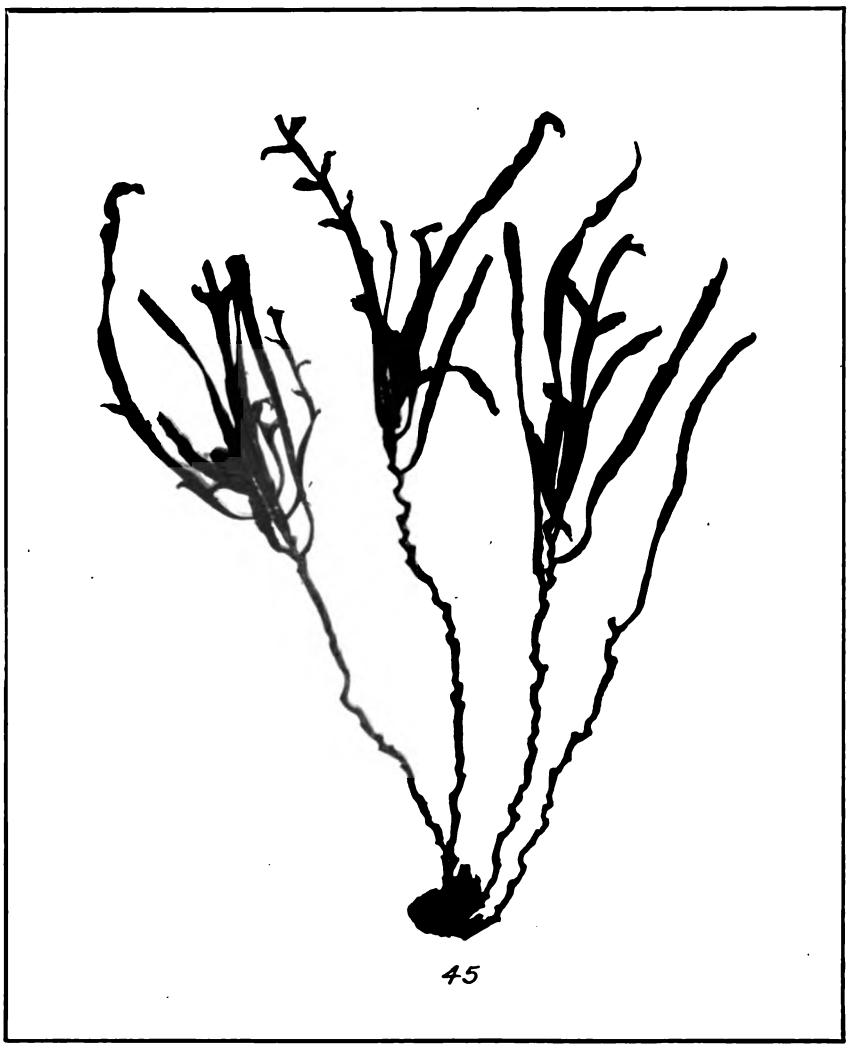

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PLATE 44

Halidrys dioica Gardner.

Fig. 46.—Showing the extreme in the branching of the mature receptacles, some arising from the air vesicles, and these branches in turn producing other air vesicles.

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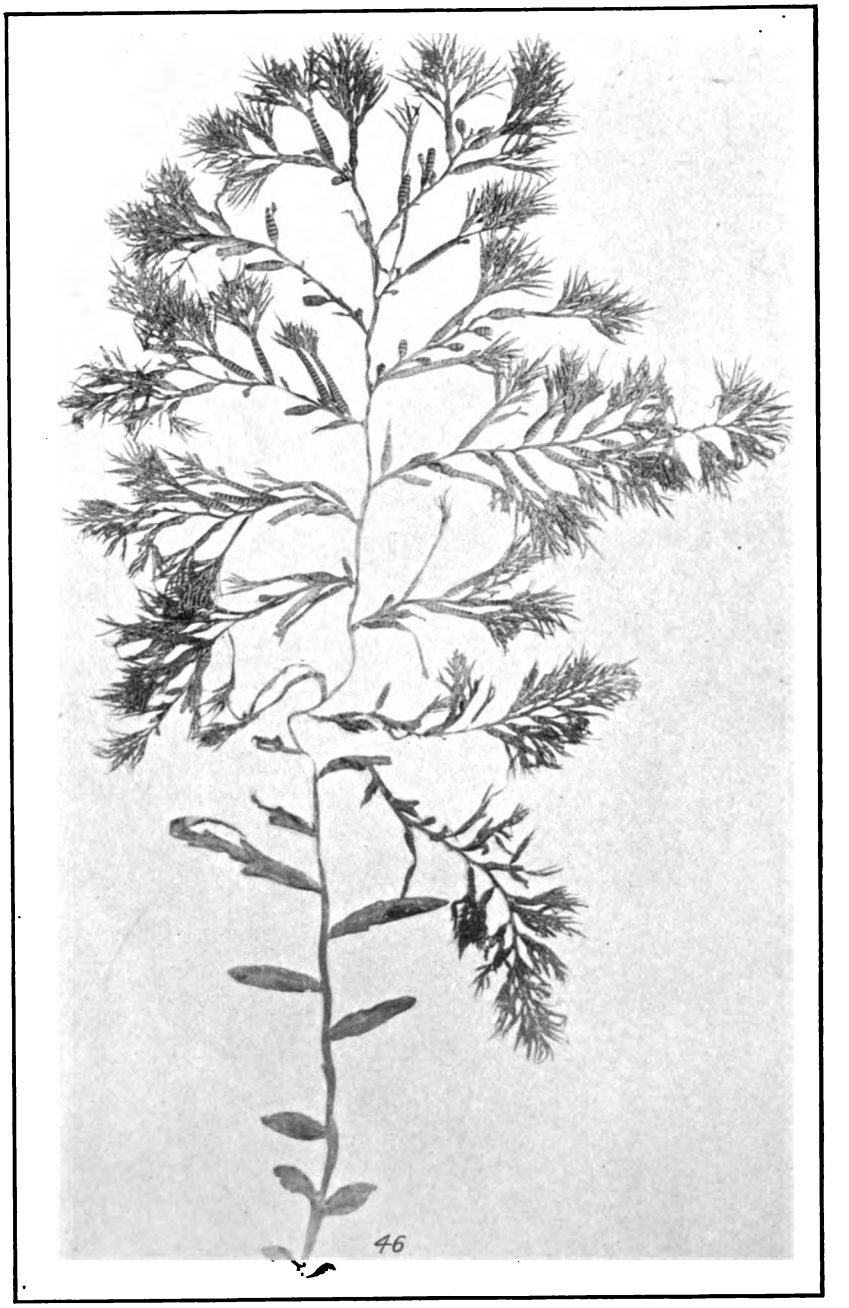

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PLATE 45

Halidrys dioica Gardner.

Fig. 47.—A part of a rare form, not quite mature, showing an abundance of small air vesicles. Much reduced.

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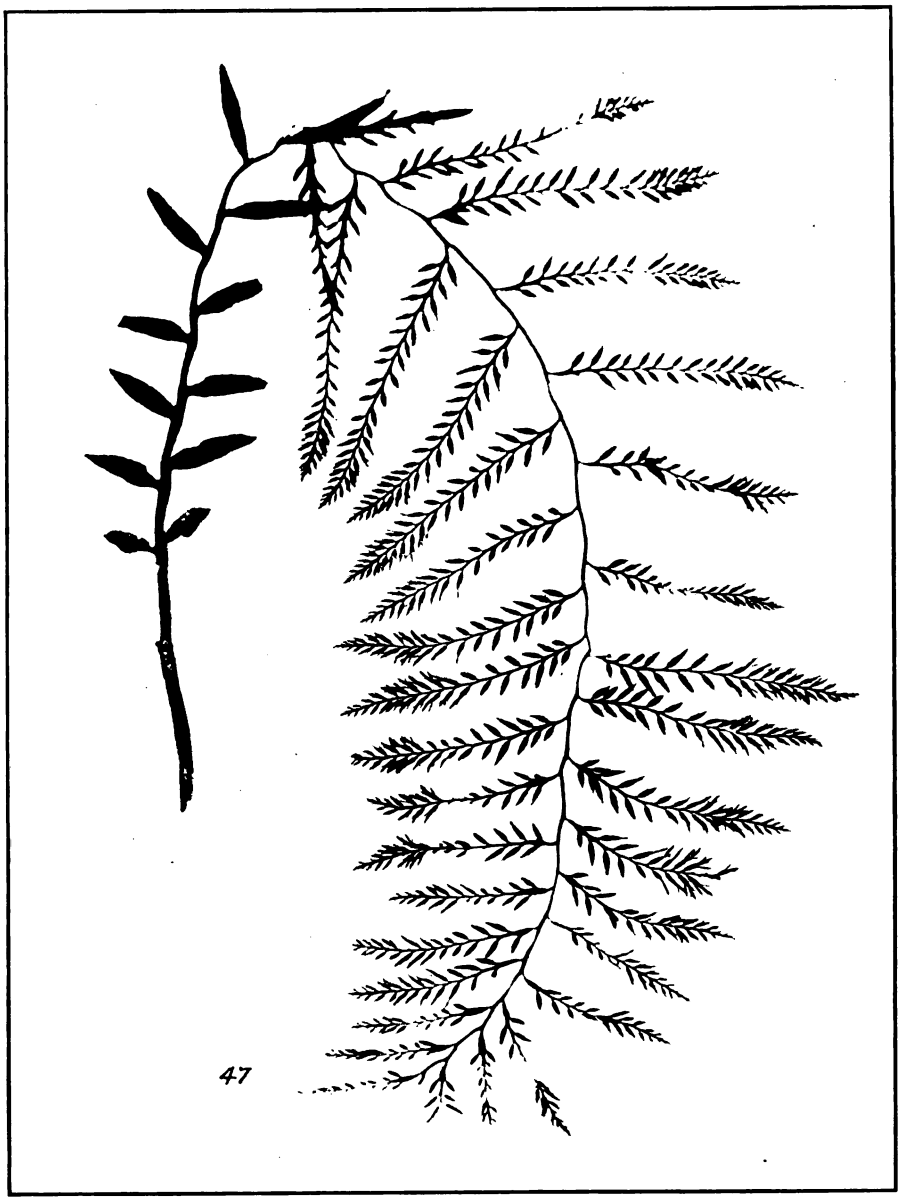

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PLATE 46

Blossevillea Brandegeei Setchell and Gardner, sp. nov.

Figs. 48–50.—Photographed from dry material. Fig. 48 represents a considerably mutilated plant, showing the base and main fronds. Fig. 50 shows the characteristics of branching. Fig. 49 shows a fruiting tip of a frond. One-quarter natural size.

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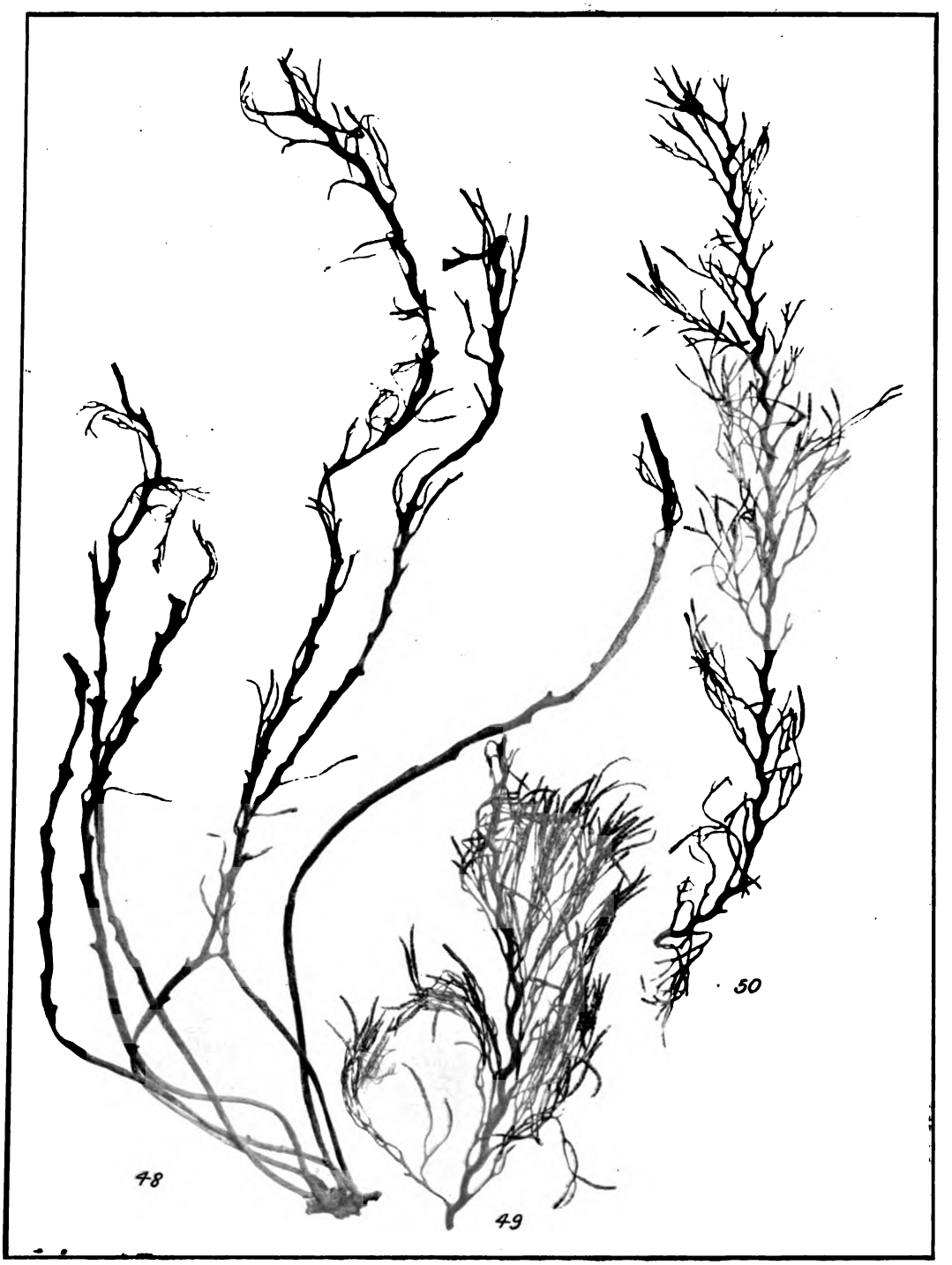

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PLATE 47

Cystoseira Setchellii sp. nov.

Fig. 51.—A young sterile frond.

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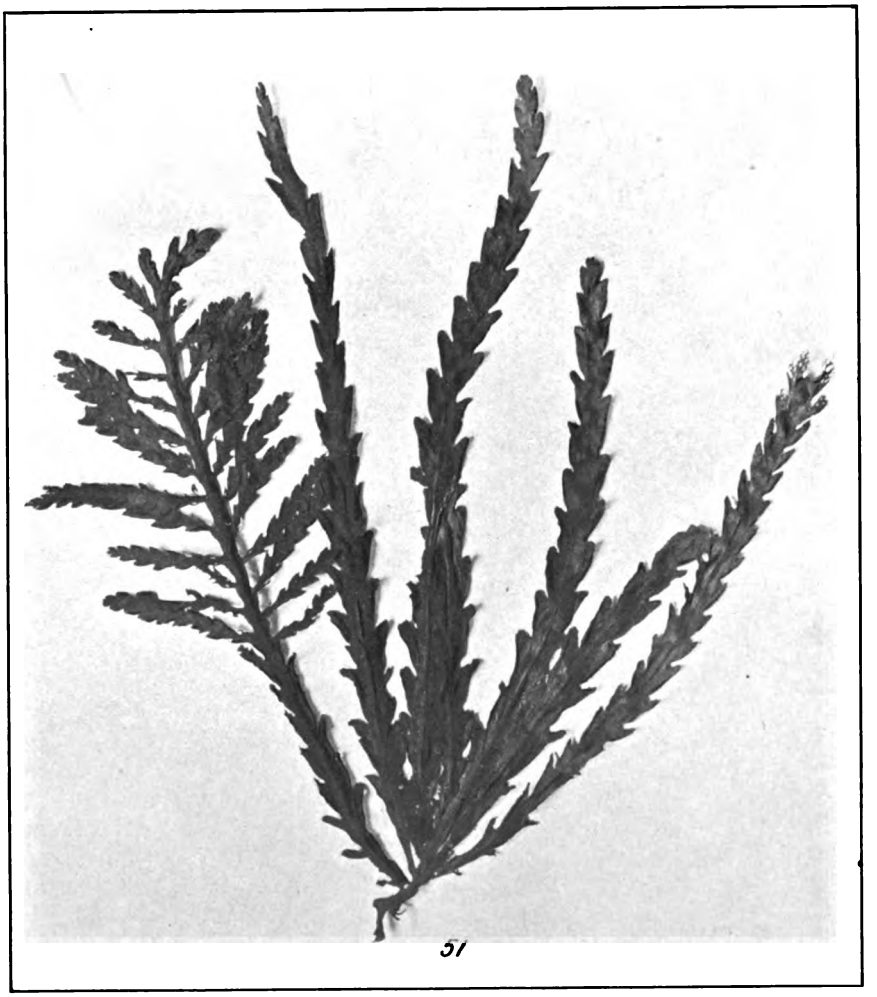

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PLATE 48

Cystoseira Setchellii sp. nov.

Fig. 52.—Part of a typical plant just beginning to fruit.

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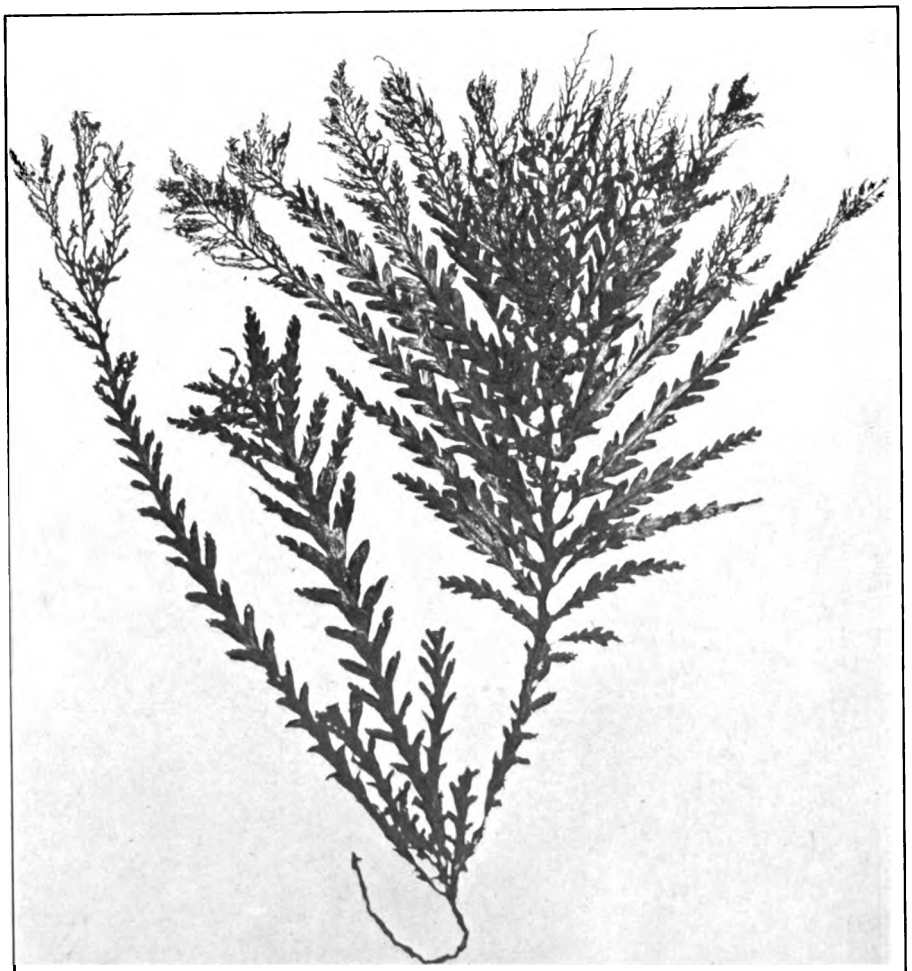

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PLATE 49

Cystoseira Setchellii sp. nov.

Fig. 53.—A mature fruiting plant.

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PLATE 50

Cystoseira Setchellii sp. nov.

Fig. 54.—Terminal portion of a frond showing the flattened serrated branches with air vesicles at their bases and a few vesicles at the bases of the fruiting branchlets.

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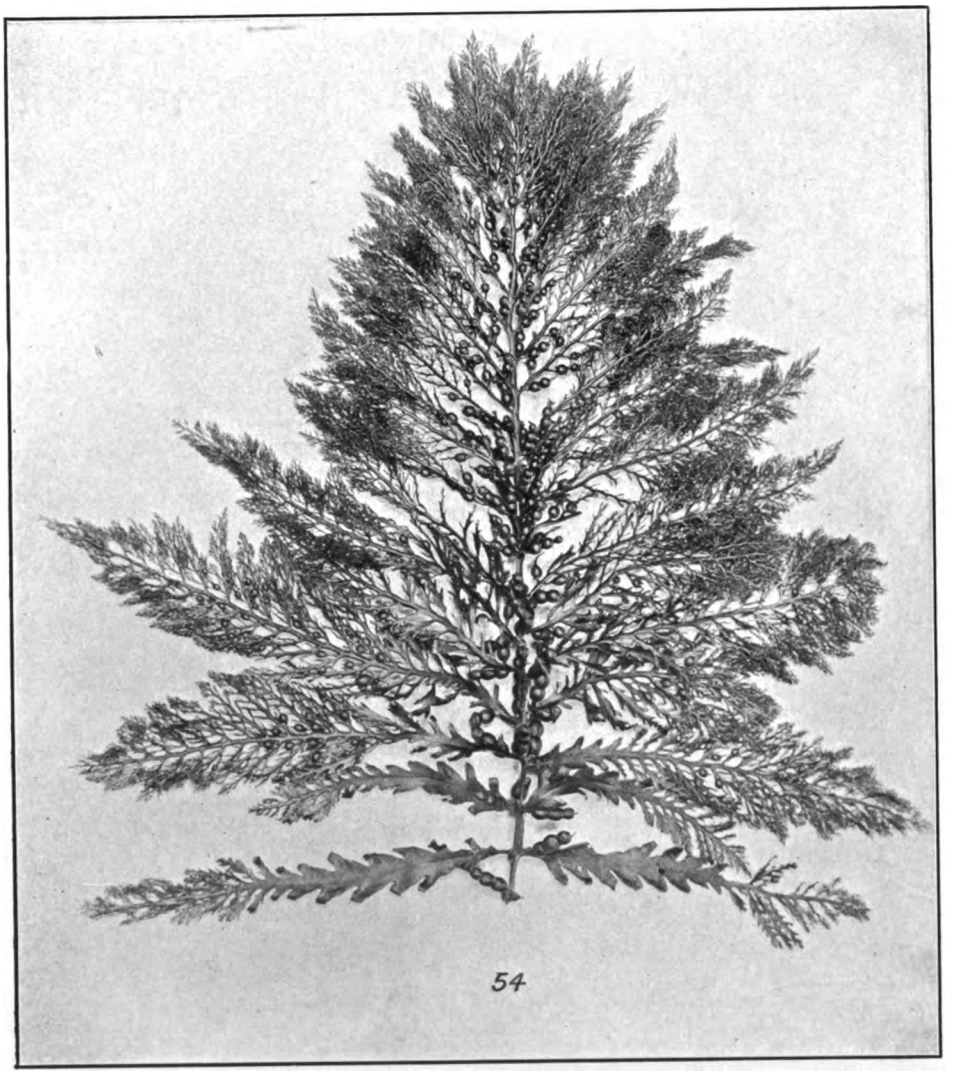

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PLATE 51

Cystoseira Osmundacea (Menz.) Ag.

Fig. 55.—Portion of a typical frond in fruit.

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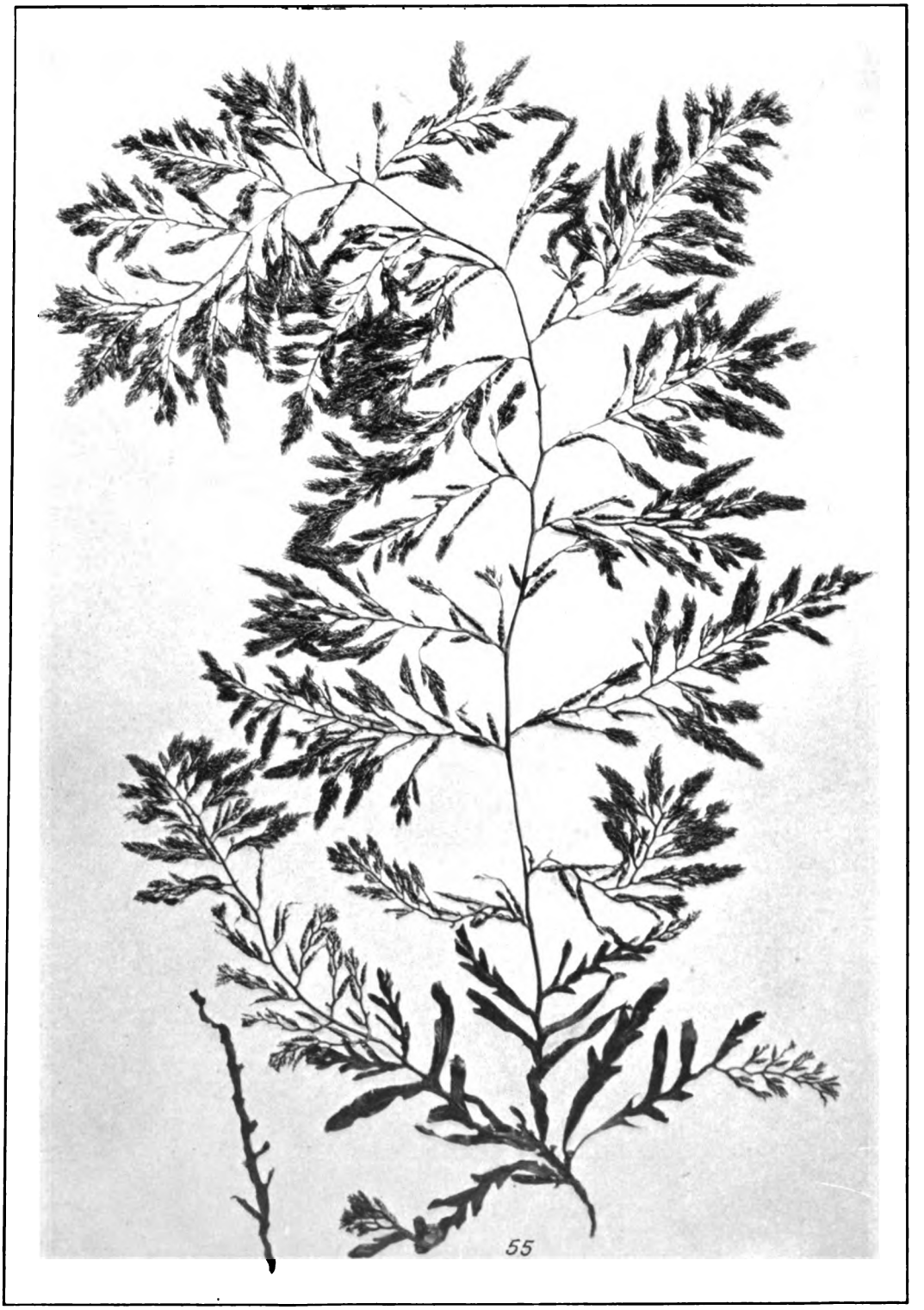

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PLATE 52

Cystoseira Osmundacea (Menz.) Ag.

Fig. 56.—Typical fruiting branches showing the position and arrangement of the vesicles with respect to the receptacles which occupy the terminal ramuli. One-quarter natural size.

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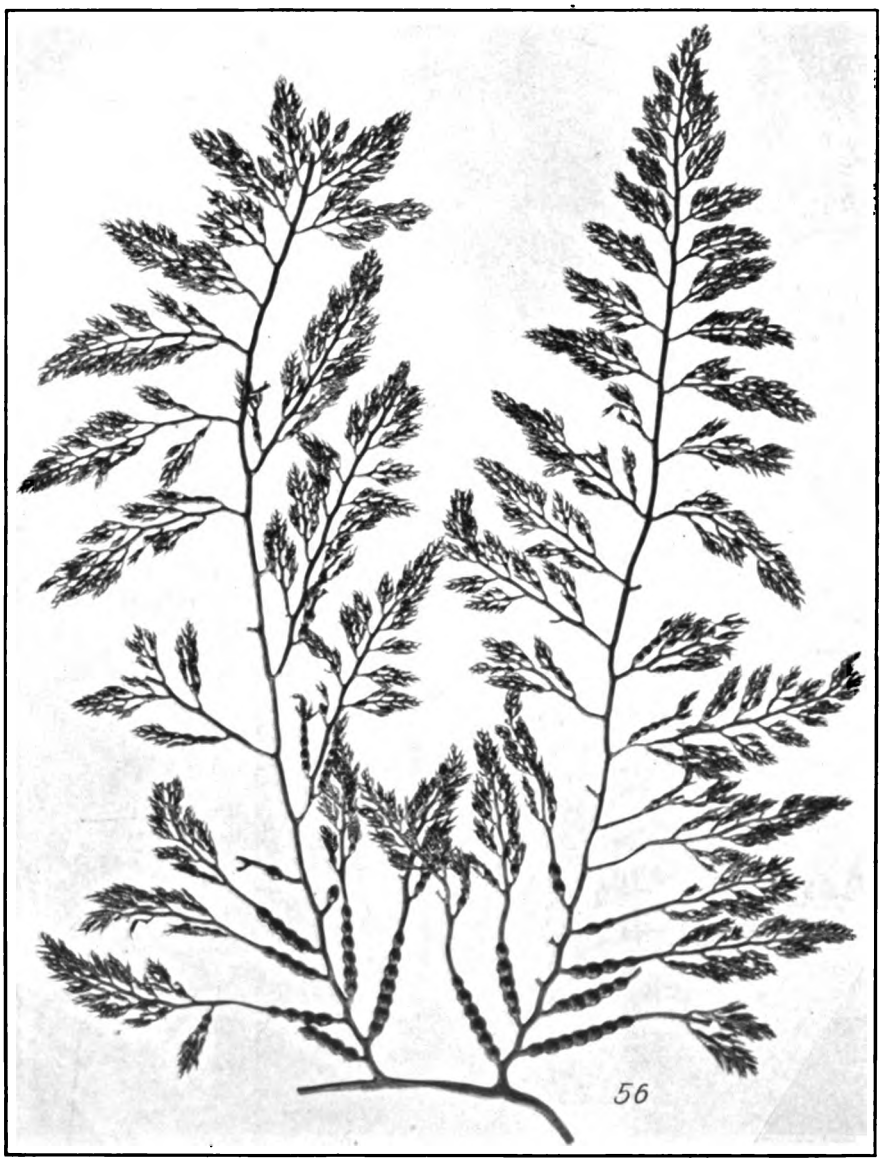

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PLATE 53

Cystoseira Osmundacea f. *expansa* (Ag.) Setchell.

Fig. 57.—Plant just beginning to fruit.

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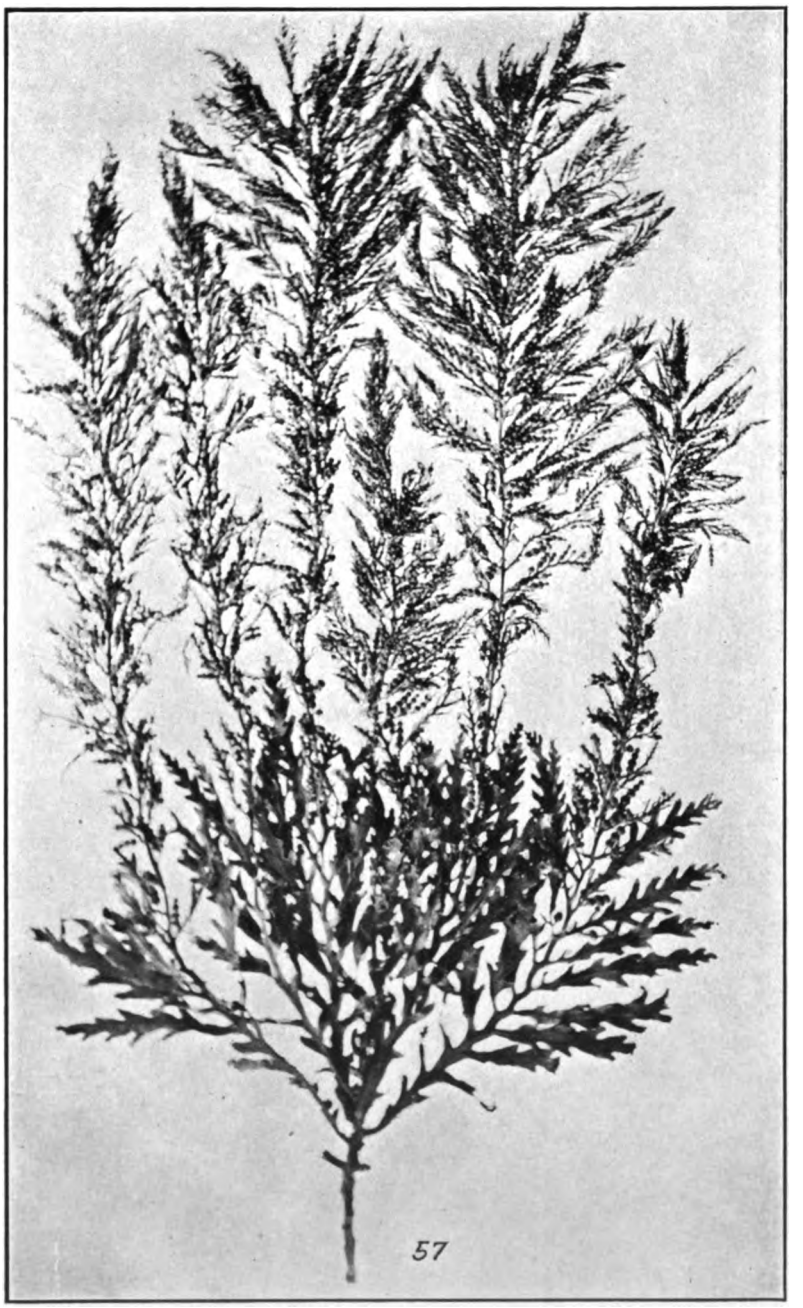

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IN
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Vol. 4, No. 19, pp. 375-388 Issued June 24, 1913

PLANTAE MEXICANAE PURPUSIANAE, V

BY
TOWNSHEND STITH BRANDEGEE

UNIVERSITY OF CALIFORNIA PRESS
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PLANTAE MEXICANAE PURPUSIANAE, V

BY
TOWNSHEND STITH BRANDEGEE

The collection of plants made by Dr. Purpus last year came mainly from the State of Vera Cruz. Misantla, Naolinco, Antigua and Baños del Carrizal in the State of Vera Cruz. The Sierra Madre between Misantla and Naolinco and Baños del Carrizal seems never to have been previously visited by a botanical collector and consequently many new or rare plants were found there.

Illicium floridanum Ellis was collected by Dr. Purpus between Misantla and Naolinco. The foliage differs somewhat from the typical form, but some variation must be allowed. The species is a native of the southeastern United States and its range is greatly extended by the discovery. Poisonous effects appear to be attributed to *Illicium* wherever it is found. The natives in the Sierra Madre claim that it poisons horses, and its common name among them is "Matacaballos."

Asimina? Purpusii sp. nov.

Frutex? cortice cinereo: ramis vetustis, glabris, juvenibus pubescentibus: foliis alternis, ellipticis, utrinque acutis, supra glabris, subtus ad venas pubescentibus, margine integris, 6 cm. longis, 2–3 cm. latis; petiolis pubescentibus, 2 mm. longis: floribus axillaribus, solitariis; pedicellis 5 mm. longis: sepalis 3, late lanceolatis, 5 mm. longis, extus pubescentibus; petalis 6, patentibus, puberulis, 18 mm. longis, 7 mm. latis, apice acutis; staminibus numerosis; antherarum connectivo apice peltato; stylis brevissimis; toro convexo: carpellis immaturis 6–10, 4–6-

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spermis, clavatis, parum torulosis, 2 cm. longis, basi solidis stipitiformibus; ovulis biserialibus.

Perhaps this plant should be described as a *Porcelia;* its generic position appears somewhat uncertain. Collected near Baños del Carrizal. No. 6276. Type, Herb. Univ. Calif., No. 168706.

Benthamantha tuberosa sp. nov.

E radicibus tuberiferis multicaulis, suffrutescens: caulibus pubescentibus, ca. 1.5 dm. altis: foliis 3–4 cm. longis, 5-foliolatis; foliolis oblongo-ovatis, basi cuneatis vel rotundatis, supra fere glabris, subtus parce pubescentibus, 10–20 mm. longis, ca. 10 mm. latis, petiolulatis; petiolis pubescentibus; stipulis subulatis: racemis folios subaequantibus, paucifloris: calycis tubo dentibus aequilongo: carina subrostrata: legumine lineari, 4 cm. longo, glabro, ca. 16-spermo.

This species seems to be very distinct from *B. Greenmaniana* (Millsp.) Britten; the other species having roots bearing tubers. Collected at Baños del Carrizal. No. 6080. Type, Herb. Univ. Calif., No. 155244.

Coursetia polyphylla sp. nov.

Fruticosa ramosa: ramorum cortice albo, glabro: foliis ca. 6 cm. longis, imparipinnatis; foliolis sepius 6-jugis, supra glabris, subtus puberulis, oblongis, apice rotundatis vel emarginatis, apiculatis, margine integris, basi rotundatis vel cuneatis, petiolulatis, usque ad 3.5 cm. longis, 1.5 cm. latis; stipulis subulatis pubescentibus: racemis axillaribus, multifloris, quam foliis multo brevioribus: calyce pubescenti, 5-dentato, dente uno angustiori; vexillo emarginato, alas carinamque subaequanti; carina breve rostrata: legumine ca. 6 cm. longo, anguste lineari, 3–5-spermo, margine undulato.

The connective of the anthers of the flowers examined is black. The color of the flowers seems to have been ochroleucous with a reddish tinge. Collected at Baños del Carrizal. No. 6076. Type, Herb. Univ. Calif., No. 155245.

Calopogonium flavidum sp. nov.

Volubile, undique flavido-hirsutum: foliis pinnatim 3-foliolatis, foliolo terminali ovato, basi apiceque acuto, 9 cm. longo, 5.5 cm. lato, lateralibus valde obliquis; petiolo usque ad 14 cm. longo; stipulis lanceolatis: floribus pallide caeruleis, prope

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apicem pedunculi longi, fasciculatim racemosis; calyce bracteato, bracteis calycis lobis 5, lanceolatis 5 mm. longis, similibus; pedicellis brevibus, basi bracteatis; vexillo obovato, calycem paululo superanti, alis longiori; carina obtusa, parva: ovario hirsuto, 7-ovulato.

The specimens have no mature fruit but the young legumes and flowers are those of *Calopogonium*. The raceme is not decidedly nodose. Collected at Antigua. No. 6275. Type, Herb. Univ. Calif., No. 168303.

Oxalis (Lotoxalis) **camporum** sp. nov.

Multicaulis e radice lignosa: caulibus basi frutescentibus, pubescentibus cum pilis adpressis adscendentibus simul pilis longioribus patulis, 2–3 dm. altis: foliolis oblongo-linearibus, apice acuminatis vel rotundatis, basi cuneatis, usque ad 2.5 cm. longis, 1 cm. latis; petiolis 2.5 cm. longis; pedunculis ca. 2.5 cm. longis; pedicellis 5–10 mm. longis: floribus umbellatis; sepalis ovato-lanceolatis, 5 mm. longis; petalis flavis, quam sepalis duplo longioribus; staminibus longioribus pubescentibus; filamentis sine appendiculis; stylis pubescentibus; stigmatibus bilobatis: capsulis oblongis, quam sepalis longioribus, deinde pendulis, angulis pubescentibus; cellulis 4-spermis.

This is the only *Lotoxalis* with unappendaged filaments credited to Mexico. Collected on rocky plains near Baños del Carrizal. No. 6038. Type, Herb. Univ. Calif., No. 149896.

Euphorbia (Tricherostigma) **latericolor** sp. nov.

Suffrutescens ramosa: caulibus glabris: foliis alternis, ovatis, acuminatis, utrinque tomentulosis, 2.3 cm. longis latisque; petiolis 3 cm. longis: cymis laxe 10–12-cephalis, axillaribus vel terminalibus; pedunculis pubescentibus, 2 cm. longis; pedicellis 3–4 mm. longis; glandulis transverse oblongis; appendicibus rubidis, 1.5 mm. longis, margine crenatis; stylis usque ad basim bifidus: capsula glabra: seminibus ovatis, foveolatis simul tuberculatis.

Nearest *E. fulgens* Karw. which has like colored appendages to the glands. Collected at Baños del Carrizal. No. 6119. Type, Herb. Univ. Calif., No. 155184.

Pedilanthus Purpusii sp. nov.

Frutex glaber: foliis obovatis, acuminatis, margine integris, basi cuneatis, ca. 1.5 dm. longis, 8 cm. latis; nervo medio valde prominenti; petiolis 1 cm. longis: involucris breviter pedicellatis,

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pubescentibus, calceiformibus, rubescentibus; glandulis in fundo appendicis 2; labio superiori bipartito, lobis acuminatis, apice reflexis; labio inferiori lobis fimbriatulis: filamentis hirtis; loculis antherarum deinde divaricatis; stylo breviter trifido: capsulis oblongis, glabris.

This is near the description of *P. Pavonis* Boiss., but the inflorescence and shape of the leaves are different. The nearly sessile few flowered cymes are arranged racemosely near the ends of the branches. The specimens lack floral leaves and mature fruit. Collected near Zacuapan. No. 5759. Type, Herb. Univ. Calif., No. 155224.

Cuphea Purpusii sp. nov.

Fruticulus plus quam 3 dm. altus, ramosissimus: ramis tenuibus, curvatis; juvenibus hirsutis simul hirtello-glandulosis: foliis ovatis vel oblongo-ovatis, acuminatis, basi cuneatis, 5–5.5 cm. longis, 1.5–2 cm. latis, supra glabris vel setulis paucis brevissimis scabriusculis, subtus paululum hirtellis; petiolis ca. 4 mm. longis, hirtellis: racemis simplicibus, caules terminantibus, 8–10 cm. longis, pubescentibus: floribus oppositis; pedicellis ca. 5 mm. longis, ebracteolatis; calycibus 8 mm. longis, pilosis, basi gibbosis; lobis subaequalibus; staminibus 9, staminodiis 2; petalis 4 albo-purpureis, anguste spatulatis, 2 brevioribus ca. 4 mm. longis, ⅔ longiorum aequantibus: seminibus ca. 10, levibus: disco erecto, ovarii adpresso.

The four spatulate petals are almost white. Collected along Rio de los Pescados, Baños del Carrizal. No. 6147. Type, Herb. Univ. Calif., No. 149833.

Tibouchina Purpusii sp. nov.

Plus quam 2.5 dm. alta, undique setulis patulis brunneis vel purpureis instructis, ramosa suffrutescens: caulibus subteretibus: foliis oblongo-ovatis acuminatis, basi rotundatis, margine indistincte serrulatis, ciliatis, 3.5–5 cm. longis, 2–2.5 cm. latis, 3–5-nerviis, utrinque parce setosis; petiolis 5–10 mm. longis: ramulorum apicibus, paucifloris; calyce urceolata, setis glanduliferis instructo; lobis quam tubo 5 mm. longo brevioribus, lanceolatis, dentatis; petalis ut videtur albis, 1 cm. longis; staminibus 10, glabris, inaequalibus; connectivo majorum basi breviter producto; minorum tuberculato: seminibus cochleatis.

As the ovary matures the glands disappear from the bristles of the calyx. Collected on the Sierra Madre between Misantla and Naolinco. No. 6104. Type, Herb. Univ. Calif., No. 146822.

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Centradenia salicifolia sp. nov.

Suffrutescens, ramosa, plus quam 3 dm. alta: caulibus tetragonis, angulis subalatis, vetustis glabris: foliis lanceolatis in eodem jugo valde inaequalibus, usque ad 13 mm. longis, 3 cm. latis, in petiolum brevem attenuatis, basi 3–4-nerviis, margine ciliatis utrinque fere glabris: paniculis ad apices ramulorum multifloris: calyce ore constricto, 4-lobato, parce hirsuto, 5 mm. longo; lobis deltoideis, brevibus: petalis purpureo-albis, 5 mm. longis; staminibus 8, iis *C. inaequilateralis* similibus sed majoribus.

This is a larger plant than *C. inaequilateralis*, to which it is very similar. The leaves are of a thicker texture and the veins more prominent. The stems, except the youngest, are glabrous and the larger more numerous flowers are differently arranged. Collected on the Sierra Madre above Misantla on wet rocky slopes. No. 6103. Type, Herb. Univ. Calif., No. 146824.

Triolena radicans sp. nov.

Herba perennis, adscendens: caulibus simplicibus, prope basim radicantibus, hirsutis, ca. 2 dm. longis: foliis oblongo-ovatis, acuminatis, subtus interdum purpureis, ad venas hirsutis, supra parce pilosis, basi inaequalibus, margine undulatis vel breviter serratis setoso-ciliatis, usque ad 12 cm. longis, 7 cm. latis, in eodem jugo inaequalibus; petiolis 2–3 cm. longis, hirsutis: spicis 10–15 cm. longis, 15–20-floris; pedunculis hirsutis; pedicellis 3 mm. longis, interdum alatis: calyce setosis; lobis deltoideis, 5; petalis 5, roseis: staminibus 10, dissimilibus; filamentis glabris; antheris 5 alternis connectivo basi incrassato; ceteris antice appendicibus clavatis 2 antheras aequantibus instructis: capsula obpyramidata, trigona, apice trialata, trivalvata: seminibus breviter clavatis, asperulis.

Only a few fruiting plants with scanty flower buds were collected. The stamens have the characters of *Diolena*, a South American genus but the calyx is that of *Triolena*. The specimens agree with the description of *T. scorpioides* in the Revision of Melastomaceae by Cogniaux except that the stems are creeping and root at the lower joints and the anthers are not exactly generic. Collected on the Sierra Madre between Misantla and Naolinco. No. 6102. Type, Herb. Univ. Calif., No. 168606.

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Menodora intricata sp. nov.

Herbacea glabra: ramis intricatis, valde costatis: foliis bracteiformibus, linearibus vel trifidis, ca. 4 mm. longis: floribus ramos terminantibus; calycis lobis ca. 10, linearibus, acuminatis, 5 mm. longis, corollae tubum aequantibus; corolla flava; lobis oblongis, obtusis, 6 mm. longis; stigmate late bilobato: fructu erecto, calycem aequante.

The specimens have no lower leaves and the upper leaves are inconspicuous. The much branched stems are strongly ribbed Collected near Minas de San Rafael, San Luis Potosi. No. 5016. Type, Herb. Univ. Calif., No. 157499.

Philibertia dumetorum sp. nov.

Volubilis: caulibus retrorsum pubescentibus: foliis orbiculato-ovatis, basi profunde cordatis, apice obtusis, acuminatis vel emarginatis, apiculatis, margine integris usque ad 5.5 cm. longis, 4 cm. latis, supra parce pubescentibus, subtus pallidioribus, pubescentibus; petiolis ca. 15 cm. longis: umbellularum pedunculis, pedicellisque ca. 1.5 cm. longis: calycis segmentis ovato-acuminatis, extus pubescentibus; corolla rotata; lobis ovato-acuminatis, 5 mm. longis; corona exteriori tenui cyathiformi, 3 mm. alta, columnam superanti; squamis coronae interioris membranaceis, magnis, ante siccationem verisimiliter rotundato-inflatis: stigmate vertice depresso. Folliculi desunt.

Few plants were collected and from them most of the flowers had fallen. Collected near Baños del Carrizal. No. 6013. Type, Herb. Univ. Calif., No. 155247.

Cynanchum mexicanum sp. nov.

Caulibus glabris: foliis oblongo-lanceolatis, acuminatis, basi rotundatis, supra glabris, subtus minute hirtellis, ca. 5 cm. longis, 1 cm. latis; petiolis ca. 5 mm. longis: umbellis 15–20-floris; pedunculis 3–4 cm. longis; pedicellis 1 cm. longis, pubescentibus: calycis segmentis ovato-acuminatis, 3 mm. longis: corolla rotata, fere ad basim lobata; lobis ovatis, 5 mm. longis; coronae squamis 5, carnosis, oblongis, stigmam superantibus, columnae brevi adnatis, basi cum membrana conjunctis; stigmate obtusis. Folliculi ignoti.

The stems are not twining. In accordance with the classification of Schumann in Pflanzenfamilien this species is described as a *Cynanchum*. It belongs to *Vincetoxicum* § *Seutera* as

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defined by Gray. Collected in the State of Vera Cruz at either Baños del Carrizal or Antigua. No. 6017. Type, Herb. Univ. Calif., No. 149950.

Vincetoxicum (Gonolobus) **megacarphum** sp. nov.

Volubile: caulibus parce hirsutis: foliis late ovatis, longe acuminatis, basi auriculato-cordatis, sinu lato, margine hirtello-ciliatis, utrinque parce hirtellis; petiolis usque ad 3 cm. longis: umbellis axillaribus, ca. 6-floris; pedunculis 1 cm. longis; pedicellis 5 mm. longis: calycis segmentis lanceolatis, ciliatis 7 mm. longis: corolla campanulato-rotata, 7 mm. alta, usque ad medium 5-lobata; lobis deltoideis, obtusis, reticulatis, utrinque glabris; columna brevissima; corona brevissime annulata, cum squamis 5 carnosis, magnis deinde atris, stigmam superantibus, instructa; stigmate radianti, vertice depresso: folliculis 7 cm. longis, acuminatis, tuberculoso-muricatis.

The corona is unlike that of any other described species of *Gonolobus*. Collected near Baños del Carrizal, Vera Cruz. No. 6014. Type, Herb. Univ. Calif., No. 149859.

Vincetoxicum (Gonolobus) **saepimentorum** sp. nov

Volubile: caulibus glabris vel bifariam tomentosis; juvenibus tomentosis: foliis oppositis, ternis quaternisque, ovatis, longe acuminatis, basi auriculato-cordatis, utrinque fere glabris, usque ad 6 cm. longis, 3.5 cm. latis; petiolis 2.5 cm. longis: racemis quam foliis multo longioribus, 3–8 cm. longis, multifloris; pedicellis 3 mm. longis: calycis segmentis oblongo-acuminatis, ciliatis, extus pubescentibus, 3 mm. longis: corolla fere usque ad basim 5-lobata; lobis oblongis, obtusis, 4 mm. longis; corona ad basim columnae, corollae adnata, annulata, alte 5-lobata, cum squamis 5, crasso-carnosis interioribus, apice incrassatis, stigmam aequantibus, instructa: columna tenui, brevi; stigmate 5-radiato, plano. Folliculi ignoti.

The arrangement of the leaves, the long peduncles and peculiar corona well characterize this species. Collected at Baños del Carrizal, growing in hedges. No. 6019. Type, Herb. Univ. Calif., No. 149949.

Ipomoea melanotricha sp. nov.

Volubilis, suffruticosa: caule hirsuto pilis nigrescentibus reflexis, 5 mm. longis: foliis in circumscriptione orbicularibus, diametro usque ad 13 cm., glabris, alte pedatim 7-lobatis, basi

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cordatis; lobis lineari-ovatis, acuminatis, basi angustatis: pedunculis 8.5 cm. longis, hirsutis; pedicellis hirsutis, ca. 4 cm. longis, apice incrassatis; sepalis aequalibus, dense hirsutis, oblongis, apice obtusis, 2 cm. longis: corolla purpurea, infundibulari, 8 cm. longa; stigmate capitato, bilobo: ovario 2-loculari. Fructus deest.

This species is near *I. setosa* Ker. but has a very different leaf. Collected at Zacuapan. No. 5747. Type, Herb. Univ. Calif., No. 163009.

Ipomoea carrizalia sp. nov.

Caules parum volubiles, striati, puberuli: foliis triangulari-ovatis, usque ad 9 cm. longis, 6 cm. latis, integris vel trilobatis, apice obtusis vel acutis, basi cuneatis, supra paululo tomentosis, subtus dense albo-tomentosis; petiolis 2 cm. longis: pedunculis 2.5–7 cm. longis, puberulis, apice 1–5-floris; pedicellis 1–1.5 cm. longis: sepalis coriaceis, subaequalibus, ovatis, apice obtusis, 6 mm. longis; corolla rosea, infundibulari, 6.5 cm. longa, basi tubo 1 cm. longo; stigmatibus 2, globosis: ovario 2-loculari; loculis 2-ovulatis: capsula breve ovoidea, sepala superanti, in valvas 2 ab apice dehiscenti: seminibus glabris, e basi densissime longissimeque lanatis.

Collected on rocky plains near Baños del Carrizal. No. 6241. Type, Herb. Univ. Calif., No. 167863.

Ipomoea pusilla sp. nov.

Volubilis e radice annua: caulibus filiformibus, parce pilosis, 2–3 dm. altis: foliis subpedato-5-laciniatis; laciniis anguste ovatis, exterioribus laciniatis, setaceo-acuminatis, margine ciliatis, supra hirsutulis; petiolis 1 cm. longis: pedunculis unifloris, 2.5 cm. longis, ultra medium bibracteolatis: sepalis lanceolatis, subaristo-acuminatis, aequalibus 4 mm. longis, dorso leviter carinatis, exterioribus hirsutis: ovario 2-loculari, 4-ovulato: stigmate capitato subgloboso, bilobo: seminibus juvenibus lanatis.

The leaves resemble those of *I. leptotoma* Torr. and *I. costellata* Torr. The specimens are young and have buds only, but the corollas are evidently to be small with acuminately lobed margins. Collected on plains near Baños del Carrizal. No. 6152. Type, Herb. Univ. Calif., No. 149878.

Ipomoea ursina sp. nov.

Caulis crassus, pilis vel setis fulvis, longis, patulis, instructus: foliis paululo pilosis, ca. 6 cm. longis, 4 cm. latis, cordato-ovatis, integris vel alte trilobis, lobo medio majori acuminato; petiolis

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2.5–3.5 cm. longis: floribus 15–20 cymoso-paniculatis; pedunculis crassis pilosis, 11 cm. longis; pedicellis ca. 2 cm. longis; sepalis coriaceis subaequalibus, oblongis, obtusis; exterioribus pilosis; corolla alba, 6 cm. longa, tubuloso-infundibulari, limbo parum patenti; antheris inclusis; stigmatibus 2, globosis: ovario 2-loculari, loculis 2-ovulatis. Fructus deest.

Collected at Baños del Carrizal. No. 6240. Type, Herb. Univ. Calif., No. 167862.

Ipomoea angustata sp. nov.

Undique glabra, volubilis: foliis in circumscriptione cordato-ovatis, 6 cm. longis, 5 cm. latis, alte trilobis; lobo centrali multo majori, longe acuminato, basi angustato; lobis lateralibus e sinu divaricato saepe alte lobatis, folium 5-lobatum formantibus: petiolis 3.5 cm. longis; pedunculis 3–3.5 cm. longis, apice bracteolatis, 1–3-floris; pedicellis 5–10 mm. longis: sepalis 7 mm. longis, fere filiformibus, basi latis subito angustatis; corolla infundibulari, 2 cm. longa: capsula ovoidea, 2-loculari, sepalis breviori, ab apice dehiscenti: stigmatibus globosis.

The dried flowers are pink in color. The capsules examined had matured but a single seed in each cell. Collected at Culiacan, Sinaloa, by T. S. Brandegee, Sept. 1904. Type, Herb. Univ. Calif., No. 105148.

Ipomoea iodantha sp. nov.

Volubilis, caulibus parce pilosis: foliis cordato-ovatis, acuminatis, apiculatis, usque ad 10 cm. longis, 8 cm. latis, sinu 2.5 cm. profundo, 7 mm. lato, fere glabris, subtus minute albo-maculatis; petiolis 5–10 mm. longis: pedunculis 1.5–2.5 cm. longis, apice 3–5-floris, bracteis foliaceis, pilosis, lanceolatis, 2 cm. longis, sepalis similibus, instructis; pedicellis ca. 2 mm. longis: sepalis 1.8 cm. longis, lanceolatis, pilis e basi pustulata hirsutis; corolla infundibulari, 2.5 cm. longa, superne violacea, tubo flavido: ovario 2-loculari; loculis 2-ovulatis.

The flowers are crowded into a head amongst the bracts. Collected by T. S. Brandegee at La Mesa, Cape Region of Baja California, Oct., 1902, and near Culiacan, Sinaloa, Sept., 1904. Type, Herb. Univ., No. 105204.

Ipomoea ornithopoda Robinson was collected by Dr. Purpus at Baños del Carrizal, extending the range of the species from the Pacific to the Atlantic coast. The leaves of the plant vary very much. Specimens from Culiacan, Sinaloa, collected at the

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same time and locality have the usual deeply parted leaves and on the same plant nearly entire ones, merely dentate.

Ipomoea conzattii Greenman has been collected by Dr. Purpus at Tehuacan, a northward extension of its previously known range.

Jacquemontia pauciflora sp. nov.

Annua: caulibus erectis longe pilosis simul pilis brevibus intermixtis, usque ad 3 dm. altis, basi interdum recte ramosis: foliis ovato-acuminatis, basi cordatis, supra stellato-hirsutis, subtus adpresse villosis, 2.5 cm. longis, 1.8 cm. latis; petiolis 6–20 mm. longis; pedunculis axillaribus 2-floris, 2–2.5 cm. longis; pedicellis ca. 1 cm. longis, glanduloso-hirtellis: corolla caerulea, 7 mm. longa, quam sepalis hirsutis ovato-acuminatis duplo longiori; stigmatibus oblongis; capsula globosa, glabra, quam sepalis breviori: seminibus rugosis.

This species in general appearance most resembles *J. Palmeri* Wats. differing in leaves not punctate, in pubescence and other characters. Collected at Baños del Carrizal. No. 6139. Type, Herb. Univ. Calif., No. 155183.

Breweria sulphurea sp. nov.

Fruticosa: caulibus aliquando volubilibus, pubescentibus: foliis late ovatis, apice acuminatis, obtusis vel minute mucronulatis, supra pubescentibus viridibus, subtus dense flavido-tomentosis ca. 7 cm. longis, 4.5 cm. latis; petiolis 2 cm. longis; floribus cymosis ad axillas foliorum parvorum ramulorum foliosorum: pedicellis 1.5 cm. longis, pubescentibus: sepalis flavido-tomentosis, ovato-lanceolatis, aequalibus, 1–3 cm. longis: stylo alte bifido; stigmatibus capitatis: ovario hirsuto, 2-loculari, 4-ovulato: corolla extus flavido-hirsuta, infundibuliformi, 1.5 cm. longa: capsula subconica, quam sepalis breviori, apice flavido-hirsuta.

The flowers are numerous from the axils of small leaves of branches, about 6 cm. long, that come from the axils of the large leaves of the main stem. The color of the corolla seems to have been a very light blue. Collected at Baños del Carrizal. No. 5998. Type, Herb. Univ. Calif., No. 155241.

Heliotropium petraeum sp. nov.

Fruticulus cinereo cortice ramosissimus: ramis juvenibus strigoso-pilosis: foliis lanceolatis, utrinque attenuatis, sessilibus, 3.5 cm. longis, 3–5 mm. latis, strigoso-pilosis, subtus albidis:

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floribus ad apices ramorum dichotome cymosis, ebracteatis; cymarum ramis ca. 1.4 cm. longis; segmentis calycis lanceolatis, 1.5 mm. longis, albo-strigosis: corolla quam calyce duplo longiori; lobis acuminatis, extus strigoso-hirsutis; fauce intus hirsuta; antheris ovatis apiculatis: fructibus strigoso-hirsutis, 4-separalibus.

This little bush was collected on rocky slopes near Baños del Carrizal. No. 6180. Type, Herb. Univ. Calif., No. 149914.

Athenaea Purpusii sp. nov.

Frutex: cortice cinereo; ramis erectis, junioribus pubescentibus: foliis alternis, ovato-acuminatis, ca. 5 cm. longis, 3.5 cm. latis, basi in petiolum attenuatis, margine integris, utrinque puberulis; petiolis ca. 1 cm. longis: floribus fortasse juvenibus, axillaribus, solitariis, nutantibus: pedicellis ca. 1 cm. longis; calyce primum 4 mm. longo, pubescenti; corolla campanulata, viridi, parva, fere usque ad basim lobata, lobis valvatis; staminibus 5, corollae prope basim adnatis; antheris quam filamentis dilatatis brevissimis multitoties longioribus, loculis parallelis demum in longitudinem dehiscentibus: calyce fructifero, aucto, inflato, membranaceo, 2 cm. longo, dentibus conniventibus.

This plant has the fruiting calyx of a *Physalis* but is described as an *Athenaea* because: it is a bush; its large anthers have short, dilated filaments that are attached to the corolla; the corolla is deeply lobed. Few specimens were collected and although they have both flowers and large, inflated, fruit-bearing calyces, there is still some uncertainty about the development of the flowers. Collected at Baños del Carrizal. No. 6225. Type, Herb. Univ. Calif., No. 155246.

Russelia Purpusii sp. nov.

Frutescens: caulibus ramisque teretibus, pubescentibus: foliis oppositis, late ovato-acuminatis, margine integris, usque ad 6 cm. longis, 4 cm. latis; superioribus bracteiformibus; supra glabris, subtus pubescentibus; petiolis 5 mm. longis: cymis axillaribus, pedunculis ca. 7 mm. longis, pedicellis aequalibus, 3–6-floris: calycis segmentis ovato-acuminatis, brevibus: corolla coccinea, cylindracea, 1.5 cm. longa: capsula ovato-acuminata.

Collected at Baños del Carrizal in rocky forests. No. 6039. Type, Herb. Univ. Calif., No. 149897.

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Jacobinia albicaulis sp. nov.

Fruticosa, ramosa: caulibus vetustis cortice albido; juvenibus pubescentibus, luteo-viridibus: foliis oppositis, ellipticis, obtuse acuminatis, margine integris, basi in petiolum marginatum cuneatis, ca. 9 cm. longis, 3.5 cm. latis, supra puberulis, subtus pubescentibus, flavescentibus: floribus cymoso-spicatis vel paniculatis ramos terminantibus: pedunculis 3-floris, ca. 4 mm. longis, pedicellis aequilongis, bracteis lineari-lanceolatis: calyce campanulato, 7 mm. longo, usque ad medium 5-lobato; lobis late lanceolatis; corolla coccinea, 18 mm. longa; labio postico erecto, breviter bilobato; labio antico usque ad basim tripartito, lobo intermedio majori, palato incrassato; staminodia 2; staminibus 2; ad medium tubi affixis; loculis antherarum linearibus, muticis, uno altius affixo; ovario disco cupulato imposito, 4-ovulato: stylo incluso pubescenti. Fructus deest.

This species is characterized by its white stems and branches, its deeply lobed anterior lip, its campulate almost deltoid-lobed calyx and the presence of staminodia. The calyx is broad and somewhat recalls that of some *Labiatae*. Collected near Baños del Carrizal. No. 6049. Type, Herb. Univ. Calif., No. 149880.

Tetramerium geniculatum sp. nov.

Herbaceum; caulibus pubescentibus, basi geniculatis ad nodos radicantibus: foliis ovato-lanceolatis, basi cuneatis, utrinque hirtellis, ca. 9 cm. longis, 3 cm. latis; petiolis 2.5 cm. longis: spicis terminalibus, ca. 8 cm. longis; bracteis exterioribus ovato-lanceolatis, pinnato-nervosis, setoso-ciliatis; nervo medio valido, apice excurrenti; bracteis interioribus linearibus, ciliatis: calycis segmentis 4, linearibus: corolla purpurea, lobis brevibus; antherarum loculis disjunctis. Fructus deest.

The exterior bracts somewhat resemble those of *T. hispidum* but it is easily distinguished by its pinnate instead of parallel veins; otherwise it is very different. Collected in damp shady forests near Misantla. No. 5956. Type, Herb. Univ. Calif., No. 166384.

Tetramerium nemorum sp. nov.

Ramosum: caulium vetustorum cortice albo; juniorum pubescenti: foliis late ovatis, acuminatis, basi truncatis vel subcordatis, utrinque puberulis, ca. 2 cm. longis, 1.7 cm. latis; petiolis pubescentibus, 12 mm. longis: floribus spicatis ramos terminantibus:

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bracteis exterioribus obovatis, acuminatis, mucronatis, pubescentibus; interioribus lineari-lanceolatis, ciliatis: calycis segmentis 5, lineari-lanceolatis, ciliatis: corolla albo-purpurascenti: ovulis 4.

Collected at Baños del Carrizal in rocky forests. No. 6071. Type, Herb. Univ. Calif., No. 146830.

Rondeletia heteranthera sp. nov.

Frutex ramis teretibus glabris: foliis ovatis, acuminatis, basi rotundatis, utrinque glabris, 9 cm. longis, 4.5 cm. latis; stipulis acutis, persistentibus; petiolis 4 mm. longis: floribus in cymas paniculatas dispositis, axillaribus; paniculis 4–5 cm. longis, multifloris: calycis tubo subgloboso, laciniis 4, parvis; corolla infundibulari, tubo angusto, elongato, 8 mm. longo, fauce parum ampliata, extus puberula, ore nuda; lobis 4, imbricatis; staminibus 4, corollae insertis inclusis; filamentis brevibus; antheris dorso medio affixis, elongatis, linearibus; loculis basi usque ad filamentum disjunctis; stylo filiformi, ramis 2 brevibus: ovario 2-loculari; ovulis in loculis numerosis: capsulis parvis, globosis, coriaceis, primum septicide dehiscentibus, polyspermis: seminibus angulatis, exalatis.

This plant does not have the obtuse anthers and loculicidal dehiscence of *Rondeletia*. *Rondeletia gracilis* as exemplified by Pringle's No. 6135 has similar bifid anthers, and a septicidal dehiscence has been noticed in other species of the genus. Collected at Baños del Carrizal. No. 6148. Type, Herb. Univ. Calif., No. 155217.

Elaterium heterophyllum sp. nov.

Caulibus parce pubescentibus striatis: foliis membranaceis, majoribus leviter trilobatis, 13 cm. longis, 10 cm. latis, apice acuminatis, mucronatis, margine undulato-dentatis, basi cordatis, sinu angusto, 3–4 cm. profundo, utrinque glabris vel minute punctulato-scabriusculis; petiolis 6 mm. longis, pubescentibus; foliis minoribus hastatis vel leviter 5-lobatis; floribus masculis in umbellis ca. 10-floris; pedunculis pubescentibus, usque ad 10 cm. longis; pedicellis ca. 6 mm. longis; calycis dentibus filiformibus, brevissimis; tubo 16 mm. longo, quam corollae laciniis linearibus duplo longiori; antheris in capitulum oblongum connatis; floris femineis calyce et corolla mari similibus: cirrhis bifidis, pubescentibus: ovario dense hirsuto: fructu immaturo dense setosis.

Collected at Antigua, growing in moist soil of shaded localities. No. 6149. Type, Univ. Calif. Herb., No. 149834.

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Laurentia insignis sp. nov.

Herbacea: caulibus sulcatis fere glabris, plus quam 2 dm. altis: foliis ovato-lanceolatis, utrinque attenuatis, glabris, margine crenato-dentatis, 6.5 cm. longis, 3 cm. latis; petiolis ca. 2 cm. longis: floribus axillaribus; pedicellis 7 cm. longis; calycis tubo hemisphaerico, diametro 7 mm.; lobis brevibus, dentatis: corolla bilabiata; tubo dorso breviter fisso, 3 cm. longo; lobis lanceolatis, 7–10 mm. longis: staminum tubo corollae ima basi adnato; filamentis usque ad medium facile separandis, tomentosis, longissime exsertis: antheris vertice setis rigidis instructis, praesertim duabus, glabris; stigmate alte 2-fido: ovario semisupero.

The appearance of this plant is that of a *Lobelia*. The dried flowers have a tinge of red. Collected on the Sierra Madre between Masantla and Naolinco. No. 6227. Type, Herb. Univ. Calif., No. 167930.

Tridax Purpusii sp. nov.

Annua, hirsuta: caulibus erectis, ca. 3 dm. altis; ramulis brevibus, basilaribus, paucis; foliis ovato-acuminatis, dentatis, in petiolum brevem cuneatis, ca. 4 cm. longis, 2 cm. latis: capitulis 3–4, caules terminantibus; pedunculis 12–18 cm. longis; involucri squamis aequalibus biseriatis, exterioribus ovato-acuminatis, extus hirsutis; interioribus oblongis, apiculatis, membranaceis; corollis' radii ligulatis, 6 cm. longis, longe tubulosis; ligulis luteis, quadratis, trifidis; pappi setis florum disci angustissimis, aristato-acuminatis, plumosis, achaenia duplo longioribus; squamis florum radii brevibus, oblongis, ciliatis: achaeniis disci sericeo-villosis; radii minus villosis.

Collected near Naolinco. No. 6035. Type, Herb. Univ. Calif., No. 149895.

Pinaropappus caespitosus sp. nov.

Glaber, caespitosus, humilis, ca. 7 cm. altus: foliis radicalibus spatulatis, acuminatis, ca. 3 cm. longis: scapis monocephalis: involucri squamis oblongo-acutis; floribus purpureis: achaeniis longe rostratis, striatis; pappi setis uniserialibus.

Collected at Boca del Monte, Puebla. No. 5816. Type, Herb. Univ. Calif., No. 164174.

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ERRATA

Page 27. For *hypercifolia* read *hypericifolia*

Page 127, line 21. For *amplictentibus* read *amplectentibus*

——, line 28. For *festigiata* read *fastigiata*

Page 143, line 15. For *pinnatifidia* read *pinnatifida*

Page 204, line 6. For *4-merous* read *numerous*

Page 335, line 15. For *Halidrys Osmundaceus* read *Halidrys Osmundacea* (as on pages 306, 333).

Page 333, line 8 from the bottom. For *Douglassi* read *Douglasii*

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